Urban and Agricultural Communities: Opportunities for Common Ground

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Foreword

Following a recommendation by the CAST National Concerns Committee, the CAST Board of Directors authorized preparation of a report on urban agriculture.

Dr. Lorna Michael Butler, Henry A. Wallace Endowed Chair for Sustainable Agriculture, Iowa State University, and Dr. Dale M. Maronek, Head of the Department of Horticulture and Landscape Architecture, Oklahoma State University, served as cochairs and lead authors for the report. A highly qualified group of scientists served as task force members and reviewers. The group included individuals with expertise in agricultural anthropology; rural sociology; horticulture; landscape architecture; agricultural, resource, and managerial economics; agricultural extension; geography and urban planning; public policy; and philosophy.

The task force prepared an initial draft of the report, which was reviewed by the credited reviewers. The task force revised all subsequent drafts and the task force and credited reviewers reviewed the proofs. The CAST Executive Committee and Editorial and Publications Committee reviewed the final draft. The CAST staff provided editorial and structural suggestions and published the report. The authors are responsible for the report's scientific content.

On behalf of CAST, we thank the cochairs, authors, and reviewers who gave of their time and expertise to prepare this report as a contribution by the scientific community to public understanding of the issue. We also thank the employers of the scientists, who made the time of these individuals available at no cost to CAST. CAST thanks all members who made additional contributions to assist in the preparation of this document. The members of CAST deserve special recognition because the unrestricted contributions they have made in support of CAST also have financed the preparation and publication of this report.

This report is being distributed widely; recipients include Members of Congress, the White House, the U.S. Department of Agriculture, the Congressional Research Service, the Food and Drug Administration, the Environmental Protection Agency, and the Agency for International Development. Additional recipients include media personnel and institutional members of CAST. Individual members of CAST may receive a complimentary copy upon request for a $3.00 postage and handling fee. The report may be reproduced in its entirety without permission. If copied in any manner, credit to the authors and to CAST would be appreciated.

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Interpretive Summary

Agriculture is an integral part of urban growth and population change. This fact is frequently unrecognized by the general public, mainstream agricultural interests, and political leaders. In many people's minds, there is the perception of a rural-urban split that results in competition for resources, separate policies, and inaccurate stereotypes. A critical need exists to gain a better understanding of our current agricultural situation and to coalesce the interests and goals of rural and urban areas. Agriculture is one way to meet this need.

This report focuses on the role that agriculture can play in serving as a common denominator between rural and urban sectors. The intent is two-fold: to move our thinking beyond agriculture's traditional production and rural roots focus, and to identify components of contemporary agriculture that can be a resource for civic leaders and planners who are challenged by issues of sprawl, vacant city lots, public desire for safe local food, and community livability.

The objectives of this report are to

- broaden understanding of agriculture in an urbanizing society;
- identify opportunities for urban and agricultural constituencies to work cooperatively toward common goals;
- document agriculture's contributions and/or services to both rural and urban sectors;
- stimulate broad debate and discussion about program and policy directions and priorities pertaining to agriculture in an urbanizing society; and
- propose ways in which contemporary agriculture, with other partners, can help meet the challenges associated with urbanization.

Agriculture's Contributions to Urbanization

This report presents an extensive discussion of the ways in which agriculture contributes to urban communities. The following topics are considered.

- **Restoration and Remediation:** storm water management, water remediation and waste water reclamation, waste recycling, carbon sequestration, and remediation of brownfields
- **Planning and Revitalization:** growth management, landscape and energy modification, indoor-outdoor air quality, insect and wildlife management, and revitalization of land areas
- **Business and Economic Benefits:** environmental horticulture and the green industry; nursery and greenhouse production; retail garden centers; landscape and interiorscape design, installation, and maintenance; turfgrass production and management; companion animal industry; aquaculture; and the equine industry
- **Individual Health and Well-Being:** human/animal relationships, plants and planted landscapes
- **Community Health and Well-Being:** community food systems such as entrepreneurial gardens and farms, farmers' markets, community supported agriculture, and farm-to-table programs
- **Recreation and Leisure:** gardening, golf, hiking, equestrian activities, wildlife and bird watching, public parks, arboreta, botanical gardens, and entertainment farms

Policy and Institutional Dimensions

Population growth and a desire for country living have fueled public interest in land management issues. According to the USDA *National Resources Inventory*, between 1982 and 1992, 29% of U. S. agricultural land converted to urban use was prime agricultural land. During 1992 to 1997, the rate of land conversion reached 2.2 million acres annually, not counting land used for transportation routes. This was 1.2 times the conversion that occurred in the previous decade.

A number of tools are in place to protect farmland. The best programs combine regulatory and incentive-

based strategies, such as the following.

• **Regulatory Programs:** agricultural protection zoning and comprehensive planning
• **Incentive Programs:** agriculture tax programs, right-to-farm laws, agricultural districts, purchase of development rights, transfer of development rights (or purchase of agricultural conservation easement programs), and private land trusts

New Visions for Urban Agriculture

This report proposes initiatives that the agricultural system, higher education, and governments must undertake jointly to remain relevant to society. Each of the initiatives has research, extension, and educational opportunities that are addressed in the report.

1. Comprehensive Planning Initiatives

- Build public understanding of the rural-urban agroecosystem
- Integrate agriculture into long-term, rural-urban comprehensive planning
- Promote knowledge of community food systems to achieve desired local/regional goals
- Use urban agriculture as a tool for improving public education and community livability
- Identify financial incentives and revenue sources for entrepreneurial urban agricultural activities
- Draw on existing resources for science-based information

2. Public Policy Initiatives

- Study agricultural land use; analyze alternative policy instruments; document land conversion and decision-making behavior; implement spatial models of land use for policy design; and identify roles for levels of government in policy and development
- Strengthen understanding of local/regional food systems; encourage policies that improve food access; promote food system sustainability; establish food policy councils; establish local mechanisms for food production, distribution, and use; and monitor consumption patterns of disadvantaged populations
- Develop policies to ensure a new generation of farmers who can interact successfully with the urbanizing society

3. Higher Education Initiatives

- Establish curricula in urban agriculture and the rural-urban agroecosystem
- Form rural-urban outreach and extension teams that include urban leaders and planners
- Monitor and analyze community food systems; educate about nutrition and diet, community gardens, food-related employment, farmer-consumer linkages, sustainable production and management systems, and food security strategies
- Facilitate public understanding of changes in the status of agriculture land, natural resources, and open space; provide outreach education on farmland protection tools and policies while maintaining neutrality and promoting diverse stakeholder participation; document successful farmer adaptations
- Identify common ground and promote bridge-building activities and policies between urban and rural constituents
- Encourage professional development on urban agriculture issues and the rural-urban agroecosystem
- Foster internal planning to share resources, identify funding sources, and build new partnerships

4. Research Initiatives

- Pursue research on urban agricultural topics in plant adaptability and production systems, urban soils, water management, and pest management
- Encourage research on entrepreneurial products, farmland preservation, and social and economic dimensions of the rural-urban agroecosystem

5. Partnerships and Collaboration Initiatives

- Broaden the mix of partners (higher education, government agencies, nonprofit organizations, private sector)
- Foster partnerships between farmers or rural people and urban planners and urban-oriented interest groups on community food systems, community greening, sustaining and remediating natural resources, wildlife and recreation issues, and watershed protection
- Encourage higher education faculty collaboration with urban agriculture partners to address urban agriculture problems and issues
- Expand cooperative extension's role in urban agriculture issues, using a team approach to address rural-urban agroecosystem issues, coalition building, land protection tools, and policies; offer urban agriculture professional development
- Initiate urban agriculture experiential learning to engage K–12 educators, undergraduates, and

graduate students in public and private colleges and universities

- Develop creative funding strategies to support an expanded rural-urban agriculture agenda; cooperate with state and federal agencies to stimulate dialogue and planning on the rural-urban agroecosystem; engage legislators, planners, business and industry leaders, and nonprofit organizations in joint proposals; create profit-sharing entrepreneurial models

Conclusions

Agriculture must be redefined in the context of urbanization. The wealth of knowledge associated with the agricultural sciences can be put to valuable use in helping to meet the challenges of urbanization. Together, rural and urban communities have the potential to create a situation beneficial to both, based on their unique resources and experiences. This situation will come about only with proactive leadership, shared resources, creative policy options, and a willingness to work together. Land grant universities, industry, traditional agricultural interest groups, and urban partners—such as metropolitan educational institutions, city leaders, and urban planners—will need to work together to embrace change and promote a new and exciting future for everyone.

Executive Summary

Introduction

Agriculture is an integral part of urban growth and population change. This fact is frequently unrecognized by the general public, mainstream agricultural interests, and political leaders. In many people's minds, there is the perception of a rural-urban split that results in competition for resources, separate policies, and unfortunate stereotypes. A critical need exists to gain a better understanding of our current agricultural situation and to coalesce the interests and goals of rural and urban areas. Agriculture is one way to meet this need.

For many people, agriculture represents a deep-seated cultural value, sometimes expressed by the satisfaction of working in the soil, spending time close to nature, enjoying the companionship of a pet, or getting to know the farmer who grows their food. This document paints a broad picture of agriculture, going beyond its traditional rural roots and production focus and moving our thinking toward agriculture as a common denominator between rural and urban sectors (Figure S.1). The report documents some of the diverse components of agriculture that are an integral part of the *rural-urban agroecosystem*, a holistic concept used to highlight the connections between rural and urban economic, environmental, and human factors, all of which are important to both rural and urban people.

Figure S.1. Rural and urban areas of Richmond, Virginia. Photo by Tim McCabe, U.S. Department of Agriculture.

The central goal of this report is to broaden our perceptions of agriculture beyond its traditional rural roots and commodity production focus. A vital need exists to meld the interests of rural and urban people to create the environment in which rural and urban populations work cooperatively toward common goals. Technology and long-distance commuting are merging what once were thought of as contrasting urban and rural values. In addition, migration and new immigrant populations are changing the face of both rural and urban areas. Now is the time to expand the way in which agriculture, and its contributions to future societal needs, is viewed.

Historically and culturally, the concepts of farming and agriculture are synonymous. With the intensification and consolidation of agriculture, however, agribusiness has assumed a more prominent economic role in U.S. agriculture. Contemporary agriculture is now defined more broadly than just "farming." Agriculture, as defined in this report, has five major components:

1. It includes the development and manufacture of biotechnologies, agrichemicals, mechanical equipment, and other technologies that enhance production capabilities, increase product safety, and improve product quality for consumers.
2. It includes conservation and preservation enterprises aimed at sustaining and remediating natural resources, and promoting eco-recreation and agritourism.
3. It includes creating and effectively managing functional, attractive landscapes that enhance the urban environment and make cities more livable.
4. It involves the producing, gathering, processing, and marketing of food, fiber, ornamental plants, and forest products for consumers.
5. It embraces the activities of people and organizations that produce, disseminate, and/or use agriculturally related information for decision-making purposes and for public education.

In the last decade, more attention has been paid to the role of the consumer because of the growing awareness of the impacts that consumers have on demand and public policies affecting community health and quality-of-life issues. The urban and suburban contribution to many of these diverse agricultural components is neither well documented nor well understood.

Rural and urban lives no longer represent contrasting styles and values. Urban and rural people want access to a similar quality of life. Both populations are intimately connected through wealth, policies, lifestyles, and goods and services that frequently originate in urban centers. Through the sheer power of the urban market place and the political sector, much of the future of rural areas is tied to that of the urban system. Today, agriculture is found in both rural and urban locations, but in differing forms and intensities and often in response to differing demands and opportunities. Today's agricultural system and its many diverse components (food, fiber, technology, remediation, conservation, landscape and environmental enhancement, and human recreational and consumption activities) are embedded into an interconnected political, economic, cultural, and ecological system that is driven largely by urban leaders and urban organizations.

Nevertheless, agriculture is a common denominator that connects both rural and urban areas. It contributes to food availability, recreation and tourism, land restoration, waste recycling, community entrepreneurship, and scenic amenities. Similarly, it competes with urban areas for the same resources, such as water, land, and energy. Agriculture has always involved relationships between people and their environment. When agriculture is carried out in close proximity to community residents, it can produce both positive and negative impacts on the neighborhood, the economy, natural areas, and wildlife.

The Rural-Urban Agroecosystem

Rural and urban areas are interdependent elements of U.S. society, which is becoming increasingly urban. This fact suggests that both rural and metropolitan environments can best be viewed as one comprehensive agroecosystem in which the component parts are mutually dependent and synergistically tied to one another. For the purposes of this report, the *rural-urban agroecosystem* is defined as a biological and natural resources system that is managed jointly by rural and urban people to

- provide services to the environment and community,
- generate direct and indirect business (including food production, food technology, and marketing) as well as health benefits to the total society, and
- contribute recreational and leisure outlets for an urbanizing society.

The concept of a rural-urban agroecosystem more accurately describes the total agricultural system because all parts of the system interact with each other and with the total system. Whether the problems considered are those such as urban sprawl, loss of farmland, pollution, water availability, or waste disposal, the connections between the economic, environmental, biological, and social factors are clear. This approach provides useful insights about who is impacted by decisions, where to go for resources to fix problems, and who to involve in identifying solutions. The synergy associated with the whole system, and a broader group of players, can generate more political clout, more problem-solving creativity, and more funding to address solutions.

Urban Agriculture Defined

Urban agriculture is a phrase that seems contrived, almost an oxymoron. Views of agriculture are not the same for everyone. *Agriculture* is a word often associated with the production of food and fiber commodities such as corn, cotton, wheat, soybeans, beef, dairy, poultry, pork, and eggs. Such production takes place mostly in the countryside, outside urban areas (Figure S.2). Yet if one considers activities that are conducted and regulated by federal and state departments of agriculture, or research and educational activities in agricultural colleges and research institutes, agriculture can be defined in a much broader way. This broader definition includes grasses, flowers, and all types of small-scale greenhouse production; horses; aquaculture; pest control measures, including those for rodents and insects; forestry and wildlife management; the food that we eat such as fruits and vegetables; human relationships built around farmers' markets and community gardens; and the quality of life in our communities. All of these components can be important to both rural and urban populations. In addition, many city dwellers have undertaken food production and community beautification programs of their own, or in groups (Figure S.3). Even traditional rural commodity production has found a place in urban and suburban areas well

beyond people's dependency on it for food and fiber. And even this description of the activities associated with agriculture neglects the many roles that agriculture plays in people's personal and civic lives: for example, home gardening, therapeutic riding, companion animal rearing, horticultural therapy, and the locally grown food that is becoming increasingly popular in restaurants.

Today's contemporary urban agriculture is a complex system encompassing a full spectrum of interests—from a core of traditional production, processing, marketing, distribution, and consumption activities to more extensive system components including recreation and leisure, business entrepreneurship, neighborhood beautification, environmental restoration and remediation, individual and community health and well-being, agroecosystem services, and economic vitality.

Figure S.2. Corn production in Colorado. Photo by Scott Bauer, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Maryland.

Report Objectives

The objectives of this report are to

- broaden understanding of agriculture in an urbanizing society;
- identify opportunities for urban and agricultural constituencies to work cooperatively toward common goals;
- document the contributions and/or services that agriculture provides to both rural and urban sectors;
- stimulate broad debate and discussion about program and policy directions and priorities pertaining to agriculture in an urbanizing society; and
- propose ways in which contemporary agriculture, with other partners, can help society meet the challenges associated with urbanization.

This report is intended for policymakers and planners, administrators and faculty of colleges and universities, and members of diverse agricultural interest groups found in urban and urban-edge communities, cities, and rural areas. Although the contents are applicable to the interests of traditional agricultural clientele, such as agriculture commodity groups, this report also has direct relevance to the needs of local government decision makers and planners, as well as to urban-oriented organizations concerned with growth and development. In addition, the contents will be informative for individuals and groups involved in consumer advocacy and local food systems work, food security and food safety, women in agriculture, environmental and farmland protection, and sustainable agriculture.

Figure S.3. Neighborhood residents in Chicago, Illinois, work in the community vegetable garden. Photo by Ken Hammond, U.S. Department of Agriculture.

Historical Context of Agriculture

Agriculture has played a particularly significant role in U.S. history. Our founding fathers, notably Thomas Jefferson and Benjamin Franklin, viewed agriculture as a way to avoid the problems and injustices of eighteenth-century Europe. Later, the U.S. Congress passed the Homestead Act to encourage westward migration and farming. The land-grant university system was created to ensure that the farm population and the working classes enjoyed the benefits of education. Federally funded research and extension programs were developed to provide additional technical assistance to farmers. Railroads provided farmers with access to markets, and in doing so, helped midwestern states build agricultural economies. These activities also helped with the development of cities and other industries. Although U.S. residents thought of themselves as an agrarian society, the close relationship between farmers, farming, and factories actually stimulated the growth of an overwhelmingly urban nation. By the end of the twentieth century, few U.S. residents had worked on a farm. Many had never seen one.

Whereas scholars have explored the transformation and structure of agriculture and the natural landscape, relatively little attention has been paid to agriculture's urban dimensions or to the social, economic, and ecological portents relative to the agricultural industry. In addition to clarifying terms such as *metropolitan* and *nonmetropolitan, urban, urban fringe, farm,* and *rural,* this report provides geographical, demographic, and historical background on

- patterns of change in U.S. agriculture and their urban relevance;
- demographic changes in U.S. society that characterize the rural-urban interface; and
- the socioeconomic features of agriculture in contemporary rural and urban areas.

Data are presented to show that agriculture in urban or metropolitan areas is significant with regard to the landscape that it occupies, the jobs that it provides, and the level of gross farm sales that it earns when compared with agriculture in rural or nonmetropolitan areas. For example, contributions to agriculture from within metropolitan areas are substantially greater than those from nonmetropolitan areas for total employment in industry and gross sales of particular commodities, such as fruits, nuts and berries, hay and silage, cotton, and dairy and related products.

Agriculture Represents an Opportunity

Urban agriculture represents an opportunity for greater social and cultural integration across differing experiences, perspectives, and demands. The outcome will be a better society for everyone. Rural and urban leaders, policymakers, and administrators in higher education can play an important role in building bridges between rural and urban sectors. Contemporary agriculture can be a resource for civic leaders and planners who are challenged by issues of sprawl, vacant city lots, clean air and water, water availability, waste recycling, safe and healthy local food, or expanded economic development.

Agricultural and Demographic Changes

An array of terms and definitions has been used to describe, locate, and classify *rural* and *urban,* and *metropolitan* and *nonmetropolitan,* counties. Because of changes in county classification systems, it is easy to misinterptet the importance of metropolitan and nonmetropolitan counties with regard to agriculture. The latest revision, applied in the 1990 census count, defined a county adjacent to a metropolitan statistical area as *nonmetropolitan* if it had 2% or more of its employed labor force commuting to central metropolitan counties. When the farm population was first enumerated in 1880, it included 21.9 million people, approximately 44% of the total U.S. population. Both the farm population and its proportion of the total population declined every decade in the 1900s. In 1991, the farm population was 4.6 million, or approximately 1.9% of the total U.S. population. Most of the twentieth century was dominated by two demographic trends:

- nonmetropolitan growth occurred because of natural increases in the population, and
- the number of people leaving nonmetropolitan areas exceeded the number entering those areas.

The Scope of Urban Agriculture

Examining agriculture through changes in metropolitan and nonmetropolitan county data suggests that our beliefs about where farming occurs, and what it contributes, may not be totally accurate. For example, since 1978, metropolitan counties have had the largest average and median number of farms. In 1997, metropolitan counties accounted for over one-half of all agricultural employment compared with nonmetropolitan counties. Also in 1997, metropoli-

tan and nonadjacent, nonmetropolitan counties averaged $108 million and $112 million in gross farm sales, respectively, compared with $89 million by adjacent, nonmetropolitan counties.

Except in the central Great Plains, much of U.S. agriculture occurs in counties defined as "urban influenced" (within statistical metropolitan counties or adjacent counties). These areas contain much of the nation's most productive agriculture and grow most of the food: 79% of U.S. fruit, 68% of vegetables, and 52% of dairy products are produced in urban-influenced counties. Between 1978 and 1997, metropolitan counties' share of the total value of crop sales rose from 38.9% to 42.2%. This gain in metropolitan crop sales is attributed partially to assigning metropolitan status in 1993 to counties that may not have been metropolitan in 1978 or in the years that followed. Nevertheless, metropolitan counties led other counties in total crop sales for fruits/nuts/berries, nursery/greenhouse, and vegetables/sweet corn/melons in each of the past five censuses. The metropolitan counties led in sales for hay/silage/field seeds in all census years except 1978 and for cotton/cottonseed in all census years except 1997.

Agriculture's Service Role

Understanding agroecosystem functions and maintaining biodiversity within the system are important for getting the most benefit from the system. Many agricultural activities can alter a highly interdependent agroecosystem. Consequently, agriculture can help to replenish and sustain agroecosystems and the subsequent agroecosystem services that benefit urban populations. When well planned and properly integrated into the urban environment, open space or natural areas (as opposed to built-up areas) provide valuable agroecosystem services to the community.

Selected examples of agroecosystem services for which agricultural sciences can contribute knowledge and expertise include storm water management, wastewater remediation, waste recycling, phytoremediation, carbon sequestration, soil retention and fertility, appropriate pesticide and fertilizer use (Figure S.4), and remediation of brownfields. These services are a valuable part of the rural-urban agricultural system. Some of these services require further research to perfect their application to issues of urbanization.

Agriculture's Benefits to the Urbanizing Society

Agriculture makes major economic and social contributions to both urban and rural areas. Some contributions are direct, as in the case of production and marketing of products and services. Other contributions, such as farmers' markets, community supported agriculture, landscape design, construction, and nursery services are indirect, and therefore more difficult to document. Less tangible benefits come from improved individual mental and physical health and community vitality. Landscape design and subsequent plant installations are both a service and a benefit. Community food systems and community gardens benefit the local economy as well as individual and community health. This report highlights urban agriculture's business and economic contributions and its benefits to individual and community health and well-being.

Recreation and Leisure

Large segments of the recreation and leisure industry are related directly to products and services of traditional and urban agriculture activities. Agricultural services today support a variety of educational, recreational, and leisure pursuits including gardening, golfing, hiking, equestrian activities, wildlife viewing,

Figure S.4. Researchers in Arizona spray a mix of common liquid dishwashing detergent and cooking oil that kills sweet potato whiteflies, as well as several common home garden pests. Photo by Jack Dykinga, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Maryland.

bird watching, and visits to tourist attractions and scenic areas such as zoos, public parks, and botanical gardens (Figure S.5). Many of these activities contribute significantly to local economies. In addition, an increasing number of traditional farm businesses are diversifying their operations to attract visitors for educational, recreational, and leisure activities. The report illustrates agriculture's contributions to recreation, leisure, and tourism industries. It identifies new chances for economic diversification of traditional farm production businesses; highlights the interdependency between urban and nonurban populations with regard to tourism, recreation, and leisure activities; and reinforces the value of partnerships between nonurban and urban areas to foster mutually beneficial educational, recreational, and tourism opportunities.

Policy and Institutional Dimensions of Urban Agriculture

Population growth and a desire for urban-fringe or rural living have fueled public interest in land management policy. Community meetings, media features, and funded research are bringing attention to issues such as sprawl, smart growth, open space conservation, and farmland protection. The future of agriculture, especially on the urban fringe, is often situated squarely in the middle of heated debates on these aforementioned issues Most people who live in rapidly growing urban areas, or in attractive rural communities, observe and experience the impacts of population growth on a daily basis.

Figure S.5. Visitors to the Chicago Botanic Garden enjoy a summer day in the English Oak Meadow. Photo by Joanne Dahlberg, courtesy of the Chicago Botanic Garden, Glencoe, Illinois.

According to American Farmland Trust, between 1982 and 1992 every state in the United States lost valuable farmland to development; during that period, 29% of the agricultural land converted to urban use was prime agricultural land. The revised 1997 *National Resources Inventory* (NRI), using a more expansive definition of land used for urban and built-up purposes, indicated that land conversion accelerated dramatically in the early 1990s. Between 1982 and 1997 the annual conversion rate was 1.2 million acres (a.) per year. During the period from 1992 to 1997, however, the conversion rate had increased to 2.2 million a. per year. The addition of roads and other transportation methods further expands the number of acres. The NRI-developed area increased from 73.2 million a. in 1982 to 87 million a. in 1992 and to 98.2 million a. in 1997.

Public authority to intervene in land markets and decisions on the private use and ownership of land largely resides with state and local government units. Farmland falls in the center of the often-contested private and common interests in land. Public interest in farmland is not well embraced by most private landowners, including farmers and ranchers. The current economic environment does little to foster the continuation of small farms, to promote sustainable farming practices, or to discourage the sale of farmland for uses that are detrimental to the environment or to surrounding communities. This is an ongoing and frequently debated issue. Congress passed the Farmland Protection Policy Act in 1981. Unfortunately, the U.S. Department of Agriculture did not implement the act for many years, and the legislation did not provide financial assistance to state or local governments for farmland protection programs. The act did require federal agencies to identify any adverse effects their programs might have on farmland protection and minimize the extent to which such programs induce unnecessary farmland conversions.

Regulatory Programs

A number of tools and techniques, each of which has strengths and limitations, are in place to protect farmland. Generally, the best programs combine regulatory and incentive-based strategies. This report discusses both types. Regulatory programs include agricultural protection zoning and comprehensive

planning. Incentive programs include agriculture tax programs, right-to-farm laws, agricultural districts, purchase of development rights, transfer of development rights (sometimes referred to as purchase of agricultural conservation easement programs), and private land trusts.

A number of political realities confront U.S. public policy for agricultural land protection. Using only police power (zoning) has had limited success in protecting and regulating farmland use. Agricultural landowners, particularly active farmers, typically voice support for farmland protection; however, they most often endorse programs that are voluntary and that provide financial incentives for owners who choose to participate. Consequently, most state and local farmland protection programs have stressed voluntary and incentive-based programs in their design. This report suggests a number of initiatives concerning agricultural and land-use policy to accommodate more sustainable urban growth patterns; needed areas of farmland protection research; and the roles of various levels of government, higher education, and stakeholders in agricultural land protection.

New Visions for Urban Agriculture

This report by the Council for Agricultural Science and Technology (CAST) presents agriculture in a new light. It identifies agriculture's current role in an urbanizing society, frames agriculture's contributions to the needs of a growing urban population, and provides insights as to how agricultural thinking must adapt to meet future societal needs. Opportunities are identified for urban leaders and decision makers who can benefit by partnering with those from nonurban areas to resolve complex environmental, health, safety, nutritional, social, and economic problems. Recommendations are offered concerning needed changes in the agriculture system, higher education and research, and various levels of government.

The extensive documentation of today's urban agriculture presented in this report suggests five important initiatives within which agriculture can play a significant role: comprehensive planning, public policy, higher education, research, and partnerships and collaboration.

1. **Comprehensive Planning Initiatives**. There is need for greater public support and understanding of the rural-urban agroecosystem; for integration of agriculture into long-term, comprehensive rural and urban planning; for expanded knowledge of community food systems and communities' cooperation in goal setting; for using urban agriculture as a tool to improve public knowledge of the issues and to make communities more livable; for financial incentives and revenue-generating opportunities in rural and urban entrepreneurial agriculture; and for awareness and use of existing research resources.
2. **Public Policy Initiatives**. Relatively little U.S. policy addresses agricultural relationships in both metropolitan and rural areas. Important policy-related issues fall into the categories of land use, food systems, and development of human capital. Land use includes analysis of alternative policy instruments, documentation of decision-making behavior, spatial land-use models for policy design, and role clarification for levels of government. Food systems policies need to address food access, public education, and research; establishment of food policy councils; food system sustainability; diversified systems of production, distribution, and use of links between customers (eaters) and farmers (producers); and improved monitoring of consumption patterns of disadvantaged populations. Human capital development needs policies to ensure a new generation of agriculturists who can interact successfully with the urbanizing society and to assist young agriculturists with access to capital.
3. **Higher Education Initiatives**. Higher education has a timely opportunity to respond to urban agriculture in several ways: through the development of curricula in urban agriculture and the rural-urban agroecosystem; establishment of rural-urban outreach and extension teams; and monitoring, analyzing, and supporting community food systems. More emphasis probably should be directed to protection of farmland and open space, and in doing so, maintaining stakeholder neutrality and balance. Bridge building between urban and rural constituents should be a high priority; this will require professional development for faculty and staff on urban agriculture issues and the rural-urban agroecosystem. Work in this complex area will necessitate careful planning to share resources, identify funding, and build new partnerships
4. **Research Initiatives**. More science-based information is needed to assist with the design and management of contemporary urban agriculture. Some topics of importance include plant adaptability and production systems, urban soils, wa-

ter management, and pest management. Research is needed on entrepreneurial products, farmland preservation, and the social and economic dimensions of the rural-urban agroecosystem.

5. **Partnerships and Collaboration Initiatives**. If agriculture is to survive in an urbanizing society, albeit in a different form, partnerships between traditional agricultural groups and urban interest groups will be imperative. Partnerships and coalitions can play a crucial role in solving problems and creating new opportunities, especially given the complexity and multidimensional issues of urban agriculture. Two of the greatest needs are to broaden the mix of partners and to bring rural people and urban-oriented groups together around issues such as community food systems, community greening, wildlife habitat, and watershed protection. Universities will be important participants in these collaborations and should encourage active involvement of faculty in urban agriculture. Cooperative extension personnel need to address urban agriculture issues in partnership with urban leaders and planners, to facilitate linkages between rural and urban interests, and to build coalitions. Higher education and government will need to develop creative funding strategies to support the new urban agriculture agenda. This development will open new possibilities to cooperate with industry, state and federal agencies, legislators, business leaders, and nonprofit organizations to stimulate entrepreneurial profit-sharing models as well as to test new models for distance learning and professional development.

Conclusions

Five domains for collaborative urban-rural problem solving with a broadened perspective and appreciation of the contribution of agriculture are identified in this report: (1) comprehensive planning, (2) public policy, (3) higher education, (4) research, and (5) partnerships and collaboration. For each category, the report suggests actions that could enhance problem-solving and planning activities.

Comprehensive planning for sustainability of rural-urban agroecosystems should include both economic and resource (human and natural) availability and replenishment. Without integrating the often-competitive needs of both urban and rural areas, however, outcomes frequently lack the elements that may contribute to regional competitive advantage and problem-solving capacity.

Only in cooperation with other partners can agriculture help to resolve the challenges facing a rapidly urbanizing society. Although their sources may differ, many of the problems facing rural and urban subsectors of our society have similar impacts. Successful response and cost-effective use of resources will require joint planning, problem solving, and cost sharing. It is incumbent on all partners to recognize that each partner brings valuable contributions and, simultaneously, derives mutual benefits.

Agriculture must be redefined in the context of urbanization. The wealth of knowledge associated with the agricultural sciences can be put to valuable use in helping to meet the challenges of urbanization. Together, rural and urban communities have the potential to create a situation beneficial to both, based on their unique resources and experiences. This situation will come about only with proactive leadership, shared resources, creative policy options, and a willingness to work together. Land-grant universities, industry, traditional agricultural interest groups, and urban partners—such as metropolitan educational institutions, city leaders, and urban planners—will need to work together to embrace change and provide a new and exciting future for everyone.

1 Introduction

This report is designed to provide guidance to policymakers, planners, educational leaders, and diverse agricultural interest groups as they seek to address the needs and interests of rural and urban communities. It proposes ways in which agriculture can make significant contributions to tough issues such as urban growth, environmental protection, and human and community health. It offers suggestions on how to build positive interfaces between rural and urban people to create a better society for everyone.

The central goal of this report is to broaden the perception of agriculture beyond its traditional rural roots and commodity production focus. Enormous changes are occurring in and around metropolitan areas (MAs), smaller cities, and in rural communities. A crucial need exists to meld the interests of rural and urban people to create a situation in which rural and urban areas work cooperatively towards common interests and goals. Technology and long-distance commuting are merging what once were thought of as contrasting urban and rural values. In addition, migration and new immigrant populations are changing the face of both rural and urban areas. This is an appropriate time to expand the ways in which agriculture and its contributions to future societal needs are viewed.

Urban agriculture is a phrase that seems contrived, almost an oxymoron. Views of agriculture are not the same for everyone. *Agriculture* is a word often associated with the production of food and fiber commodities such as corn, cotton, wheat, soybeans, beef, dairy, poultry, pork, and eggs. Such production takes place mostly in the countryside, outside urban areas. Yet if one considers activities that are conducted and regulated by federal and state departments of agriculture, or research and educational activities in agricultural colleges and research institutes, agriculture can be defined in a much broader way. This broader definition includes grasses, flowers, and all types of small-scale greenhouse production; horses; aquaculture; pest control measures, including those for rodents and insects; forestry and wildlife management; the food that we eat such as fruits, vegetables, and fish; and the communities in which we live. All of these components can be important to both rural and urban areas. In addition, many city dwellers have undertaken food production and community beautification programs of their own, or in groups. Even traditional rural commodity production has found a place in urban and suburban areas. And even this description of the activities associated with agriculture neglects the many roles that agriculture plays in people's personal and civic lives: for example, community gardening, therapeutic riding, companion animal rearing, horticultural therapy, and the culture of farmers' markets.

Any attempt to expand the concept of agriculture will be somewhat controversial; it is, therefore, important to explore the possible sources of disagreement and misunderstanding. In part, this is a symbolic issue. The sharp distinction between urban and rural areas is a recurring theme throughout U.S. history. Town and country are often thought to represent contrasting values and lifestyles. In part, it is a matter of the way that definitions of *rural*, *urban*, and *agriculture* are woven into legal and governance structures. Power and money are at stake. Power is at stake because farmers, farm groups, and politicians representing agricultural districts and special interests have established relationships with legislative agricultural committees, state and federal departments of agriculture, and state and federal agencies regulating farm production. Urban constituents have done the same. Money is at stake because these terms are written into laws and court decisions that have consequences for property rights, entitlements, and regulations. For example, agricultural land receives tax abatements in all states. The redefinition of any key terms could destabilize power relationships or financial preferences. People who think that they might lose or gain from such changes are very attentive to the definitions of *farm* and *nonfarm*.

There are other money matters that may not be as evident to casual observers. In most states, for example, research and teaching about basic food commodity production and turf management for parks

and golf courses are conducted at state agricultural universities. Similarly, state agencies overseeing pesticide use divide their time between farmers and structural pest control companies. When funding for these activities is fixed, doing more to serve urban people who enjoy parks or have their homes sprayed for insect pests may mean that these organizations do less for farmers. When representatives of universities or state agencies start talking about urban agriculture, farmers can become nervous. Rarely is attention paid to the partnerships that may benefit both groups.

Historically and culturally, the concepts of farming and agriculture are synonymous. The intensification of capital and energy use has meant, however, that agribusiness steadily has become a more important part of U.S. agriculture (Schusky 1989). Thus, today's *agriculture* is defined more broadly than *farming*. It has at least five major components:

1. It includes the development and manufacture of biotechnologies, agrichemicals, mechanical equipment, and other technologies that enhance production capabilities, increase product safety, and improve product quality.
2. It includes conservation and preservation enterprises aimed at sustaining and remediating natural resources and promoting eco-recreation and agritourism.
3. It includes creating and effectively managing functional, attractive landscapes that enhance the urban environment and make cities more livable.
4. It involves the producing, gathering, processing, and marketing of food, fiber, ornamental plants, and forest products for human and nonhuman consumers.
5. It embraces activities of people and organizations that produce, disseminate, and/or use agriculturally related information for decision-making purposes and for public education.

In the last decade, more attention has been paid to the role of the customer or user of products and services because the customer influences demand and public policy, thus affecting community health and quality-of-life issues. The urban share or contribution to many of these diverse agricultural components has not been documented well.

Rural and urban lives no longer represent contrasting styles and values. Urban and rural people want access to a similar quality of life and to comparable amenities. Both sectors are connected through wealth, policies, lifestyles, and goods and services that frequently originate in urban centers. Through the sheer power of the urban marketplace and the political sector, much of the future of rural areas is tied to the urban system. The mutual needs of both rural and urban people frequently overlap (e.g., at farmers' markets, shopping centers, restaurants, health care and various service facilities, schools and universities, and recreation and tourism outlets).

Today, agriculture is found in both rural and urban areas, although in differing forms and intensities, and often in response to differing demands and opportunities. Unlike the agriculture of the past, today's agricultural system and its many diverse components (food, fiber, technology, remediation, conservation, and human recreational and consumption activities) are embedded in an interconnected political, economic, cultural, and ecological system driven largely by urban leaders and urban organizations. Agriculture is a common denominator connecting both rural and urban areas. It contributes to food availability, recreation and tourism, waste recycling, and scenic amenities. Similarly, it competes with urban areas for resources such as water, land, and energy. Agriculture always has altered our relationships with the environment. When it is carried out in close proximity to other people, it can produce both positive and negative effects on the community and natural resources.

The Rural-Urban Agroecosystem

Rural and urban areas are interdependent components of the U.S. society, which is becoming increasingly urban. Considering the changes occurring in both agriculture and MAs, scientists contend that both rural and metropolitan environments are one comprehensive agroecosystem in which the component parts are mutually dependent and synergistically tied to each other. The earth's ecosystems consist of biological and natural processes providing a wide range of benefits to human society. These benefits include food, fiber, and other products; recreational opportunities; and services such as clean water, healthy soil, and erosion control (Clark, Jorling, and Merrell 1999; Wood, Sebastian, and Scherr 2000).

For the purposes of this report, the *rural-urban agroecosystem* is a biological and natural resources system managed jointly by rural and urban people (1) to provide services to the environment and community, (2) to generate direct and indirect business (in-

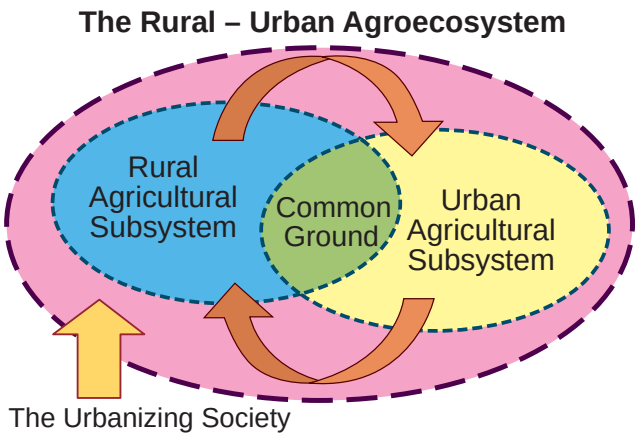

Figure 1.1. Understanding the functionality of the rural-urban agroecosystem within an urbanizing society can be helpful in establishing how parts interact with each other and areas of common ground to ensure the health of the whole society, including the total agricultural system.

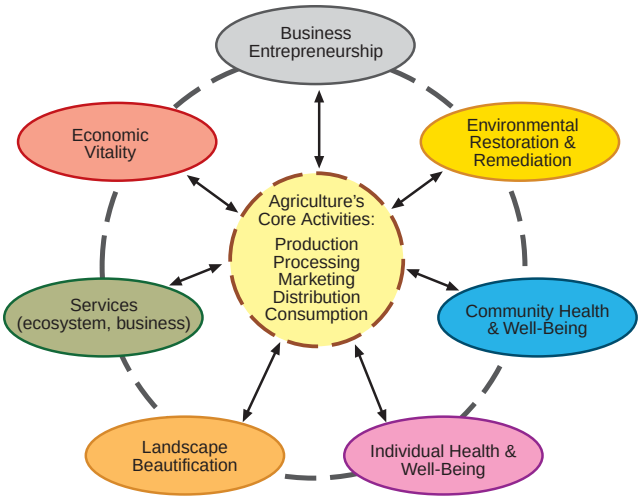

Figure 1.2. Today's urban agriculture system is a complex system composed of a central core of activities along with a wide variety of services and outcomes that support the total population.

cluding food production and marketing) and health benefits for society as a whole, and (3) to contribute recreation and leisure outlets for an urbanizing society (Figure 1.1).

The concept of the rural-urban agroecosystem may help us understand the organizational complexity of the total agricultural system and the way in which all parts interact with each other and with the total system. Whether problems such as sprawl, loss of farmland, pollution, or water availability and uses are considered, the interactions among economic, environmental, and human factors provide useful insights about influential networks, relations between issues, and locations of problem-solving resources. Innovative solutions to complex but interrelated problems can be articulated more clearly when viewed as a whole and have the potential to produce more effective solutions. The synergy associated with the whole system can generate more clout, more excitement, more creativity, and more resources.

The ultimate goal of the rural-urban agroecosystem is to develop a self-sustaining system for future generations. The agricultural system should not be viewed by itself. The sustainability of the total ecosystem is dependent on the relation between agriculture and rural and urban populations, and on understanding the needs and contributions of each in sustaining the whole ecosystem. James Horne, president of the Kerr Center for Sustainable Agriculture, in a discussion of sustainable agriculture, questioned the ethics of passing on a degraded resource base, an agriculture that does not work, and a deteriorating economy to our children and children's children. He stated, "At stake is 'intergenerational equity,' the well-being of the next generations who are depending on us to make the right choices today" (Horne 2001, 249). Any discussion of sustainable agriculture is inadequate, however, if it does not include an appreciation and understanding of the relation between agriculture and the nonfarm population, or the rural-urban agroecosystem.

Urban Agriculture Defined

For the purposes of this report, *urban agriculture* will be defined as a complex system encompassing a spectrum of interests, from a traditional core of activities associated with production, processing, marketing, distribution, and consumption, to a multiplicity of other benefits and services that are less widely acknowledged and documented. These include recreation and leisure activities, economic vitality and business entrepreneurship, individual health and well-being, community health and well-being, landscape beautification, and environmental restoration and remediation. The complexity of today's urban agriculture system is illustrated in Figure 1.2.

Objectives

This report has five primary objectives:

1. to broaden the understanding of what agriculture

is in an urbanizing society;

2. to identify opportunities for urban and agricultural constituencies to work cooperatively toward common goals;
3. to document the contributions and/or services that agriculture provides to both rural and urban sectors;
4. to stimulate broad debate and discussion about program and policy directions and priorities pertaining to agriculture in an urbanizing society; and
5. to propose ways in which contemporary agriculture, with other partners, can help society meet the challenges associated with urbanization.

Historical Context of Agriculture

Agriculture traditionally has been thought of as rural in place and occupation. This is so partly because early societies were preoccupied with subsistence food production. To understand the bases for conflicting opinions about the possible meanings and interpretations of the phrase *urban agriculture*, it will be useful to examine the history of attitudes about farms and cities, how the social context of agriculture changed throughout the twentieth century, and what the realities are today.

City and country have represented contrasting values and lifestyles in many human societies, and especially in the European tradition. For much of European history, country life has meant isolation. News came slowly, if at all, and the circle of associates for country people was somewhat narrow. In contrast, city life presented more opportunity for commerce and interaction with a wider circle of people. City people were thought to be more sophisticated, better educated, and wiser to the ways of the world. Cities were crowded, however; sanitation often was poor; and crime could be pervasive. Country life was healthier, especially for the poor, and country folk were thought to be more virtuous. These realities of the distant past became the basis for stereotypes that continue to influence ideas of city and country today.

Agriculture has played an especially significant role in U.S. history. Founding fathers such as Thomas Jefferson and Benjamin Franklin thought that the new nation, by emphasizing agriculture, would avoid the horrors, pitfalls, and injustices they saw in eighteenth-century Europe. Throughout the nineteenth century, the U.S. Congress undertook a number of initiatives to extend the original vision of Jefferson and Franklin. It passed the Homestead Act, encouraging westward migration for people who would domesticate the wilderness by farming. It created the land grant university (LGU) system as a way to ensure that the farm population and the working classes enjoyed the benefits of education. It later added federally funded programs of research and outreach to provide technical assistance to farmers. Railroads were encouraged to provide farmers with access to markets, and many midwestern states built their economies on meat, milk, and grain.

Of course, these activities also allowed the United States to develop great cities and industries. Building the railroads may have been understood as helping the farmers, but doing so required a steel industry and a huge commitment of labor to the task of clearing grade and laying track. Once built, the railroads meant that food could be delivered cheaply to workers in the manufacturing centers growing on the East Coast. Furthermore, the food system itself came to be much more than farming. To move commodities, a transportation industry was required, and thus large companies to ship and to store grain were developed, as well as those to build and to service the necessary infrastructure. Of course, food had to be delivered to consumers by grocers and later by restaurateurs. Farming itself came to depend on equipment manufacturers and seed and chemical companies. Although U.S. residents thought of theirs as an agrarian society, all these activities to help the farmer, farm, and factory actually constituted a symbiotic relation leading to the growth of an overwhelmingly urban nation. By the end of the twentieth century, few U.S. residents had worked on a farm. Some had never seen one.

Urban agriculture is an underrecognized but significant component of agriculture that is multidimensional in its functions and contributions. One aspect of urban agriculture includes the producing, processing, marketing, and consuming or using of food, fiber, ornamental plants, and services. Many of these activities occur within urban and urban-fringe areas. Urban agriculture also includes a myriad of social and economic services and activities associated with recreation, leisure, tourism, health care, and maintenance. Agribusinesses and the conservation and preservation sectors are composed of such things as tools and equipment sales and services, irrigation design and installation, input supply, retail sales, product development, remediation, education, and information. They are major players in the total urban agricultural system. Similarly, the equine and aquaculture industries, which are both recreational and major agri-

businesses, often are overlooked as contributors to the agricultural sector. This report addresses the social and demographic factors contributing to urban agriculture, its geographic patterns across the United States, and its structural characteristics in urban areas.

In his powerful book *Nature's Metropolis*, William Cronon (1991) wrote of the complex and intricate linkages growing between city and country during the second half of the 1800s. Although his focus was on Chicago and the Great West, his account of the structure of agriculture and urban expansion contained important vignettes of social and economic change applicable to the entire U.S. landscape. He spoke of how technology changed agricultural production, as well as the transporting, processing, and marketing of food and fiber in regional urban centers. He pointed to the eventual transformation of a once predominantly agrarian society to a more urban one with consumer demands for greater and more specialized goods and services.

Cronon (1991) made several key distinctions in *Nature's Metropolis*. One distinction was between *farming* and *agribusiness*: *farming* was at one time almost synonymous with *agriculture*, but over time agriculture became more complex, differentiated, and specialized. Farming per se became only one component of an agricultural industry in which the production and processing of food and fiber became economically and geographically separated in the United States. Farm produce increasingly was graded for quality and differentiated as commodities for demanding consumer and investment markets. Although commodities are grown on farms, they generally are graded at urban centers. As noted elsewhere in this report, a second distinction for Cronon was simply between rural and urban life. The process of rural people's sending grain, lumber, and livestock to urban centers in return for exotic materials and a variety of merchandise exemplified the linkage and mutual dependency between these two sectors. Finally, Cronon distinguished an ecological and spatial hierarchy between "cores" and "peripheries." The growth of urban centers was but one of many expressions of the new market system, which involved geographical flows of resources, capital, and credit between large urban metroplexes and small rural communities. Reflecting on the ecological hierarchy, Cronin noted the following:

> Beyond the central city lay the zone of intensive agriculture, filled with orchards, market gardens, dairy farms, and feedlots; beyond it the zone of extensive agriculture, with its farms raising mainly wheat and corn; beyond it the zone of livestock and lumber production; and beyond it the zone of hunters, where fast disappearing game species were opening new niches for cattle, to say nothing of farmers, miners, lumbermen. Each element of this new market geography had its roots in the original ecosystems that had assigned pine trees to the north woods and bison to the Great Plains. But each was no less affected by its distance from the city and its ability to pay the transport costs of getting there (Cronon 1991, 266).

Over the years, much scholarly interest has existed in exploring the transformation and the structure of agriculture and the natural landscape (Hallberg, Spitze, and Ray 1994). This process, however, has largely ignored the social, economic, and ecological portents of the urban dimension relative to those of the agricultural industry. Cronon's insights raise three questions: What is the historical pattern of change in U.S. agriculture, and its urban relevance? What recent demographic changes in U.S. society have occurred that characterize the rural-urban interface? What are the socioeconomic features of agriculture in contemporary rural and urban areas in the United States?

Answers to all three questions require that particular concepts be defined to provide a clear basis for discussion and assimilation of ideas. A specific time period must be established to frame the evolution of change. Thus, the use of a standard geographical unit of study and the assumption that a heterogeneous distribution of urban agriculture characteristics exists in a community are required.

The United States has a history of geographical, demographic, and economic expansion. Agriculture played an important part in sustaining that expansion. Farming and farms defined rural life and rural communities for decades. Indeed, as the U.S. population shifted from residing and working in rural areas to urban areas, the public romanticized rural areas and farming by associating them with images of individual autonomy, nurturing family life, and community spirit. In short, it created the "rural myth" (Goldman and Dickens 1983) that agriculture is simply farming and that farming is a rural phenomenon, a myth in which many continue to believe. Although agriculture continues to contribute to U.S. economic prominence in the world, agriculture is not simply farming. The available statistics document primarily gross sales of agricultural commodities. This practice clearly overlooks the many other economic and

social components of agriculture that generate both tangible and intangible values for an urbanizing society. Agriculture's many contributions are not confined to rural areas. They are an integral part of the rural-urban agroecosystem.

Demographic and economic data show that when compared with rural or nonmetropolitan agriculture, urban—or metropolitan—agriculture (see Background and Situation section, page 18) is significant in terms of the landscape it occupies, the jobs it provides, and the level of gross farm sales it earns. If all agriculture's contributions were quantified within MAs, urban agriculture's contributions would be substantially greater. Contemporary agricultural participants (producers, marketers, service providers, consumers, and others) include both rural and urban people, who face similar economic, natural, and safety risks. The economic crisis affecting farming during the 1980s, the more recent restructuring of farm policy, and the increased global competition certainly have contributed to the increasing decline in the number of farm operations. But there has never been a farm policy, a rural policy, or a metropolitan policy that includes the cross-cutting dimensions of urban agriculture. To ensure benefits to all participants, broad-based planning partnerships and inclusive policies must be encouraged. Agricultural participants in metropolitan counties may have weathered such conditions better than producers elsewhere, especially those in nonadjacent, nonmetropolitan counties. History suggests that because agricultural participants in metropolitan states were closer to larger and more diverse economies, they had the advantage of attaining alternative sources of off-farm employment and entrepreneurial links to consumers. Much still is unknown, however, about their operational characteristics, their niches in local and regional economies, and changing customer demands in metropolitan and surrounding areas. Agriculture's contributions to metropolitan or urban areas are discussed in the chapters that follow.

Agriculture Represents an Opportunity

Urban agriculture represents an opportunity for greater social integration across differing experiences, perspectives, and demands, with the ultimate goal of a better society for everyone. Urban leaders, policymakers, and educational leaders can play an especially important role in building bridges between rural and urban sectors. Agriculture can be a resource for civic leaders and planners challenged by issues of sprawl, vacant city lots, public desire for safe and healthy local food, and improved quality of life. It is a continual struggle for urban and urban-edge farmers to hold on to fertile land in the face of high land-values, inflated taxes, and misunderstandings with neighbors. Litigation and miscommunication can divide farmers and their nonfarm neighbors. Yet an array of possibilities exists for applying current knowledge to the resolution of urban environmental and community problems. Examples include low-maintenance landscaping for water conservation, forest and horticulture landscape management for decreasing noise and air pollution and personal stress, habitat restoration for water quality and public recreation, and community-supported food systems for improving community goodwill and business profitability. The experience of LGUs in strengthening community vitality could be applied to local food and landscape initiatives for enhancing the natural environment and stimulating entrepreneurship.

Neither civic nor educational leaders can ignore their responsibilities to help create a livable, sustainable society for all. Whereas it is impossible to resolve environmental and community problems alone, much can be accomplished together. A holistic approach suggests the value of addressing the total socioeconomic and ecological system rather than limiting attention to a few components. The agricultural world is a crucial part of the whole. It is a subsystem composed of interrelated human, economic, ecological, and biological forces (Figure 1.3). In community problem solving, each part is crucial to the whole. This report attempts to describe further a new agricultural system and to identify opportunities for agriculture to contribute to an urbanizing society. This report also encourages civic leaders, planners, and institutions of higher education to join forces to resolve the many challenges facing both rural and urban communities. Central to this process is the importance of broad public debate and discussion about potential policies and programs able to contribute to a beneficial situation for everyone, regardless of where they live.

This report is directed to (1) policymakers and planners at all levels of government, (2) administrators and staff at educational institutions, and (3) diverse agricultural interest groups (commodity, value-added, alternative, consumer, environmental, etc.). Policymakers and planners in metropolitan, suburban, and/or rural areas are central to this discussion in that issues of sprawl, environmental protection, business

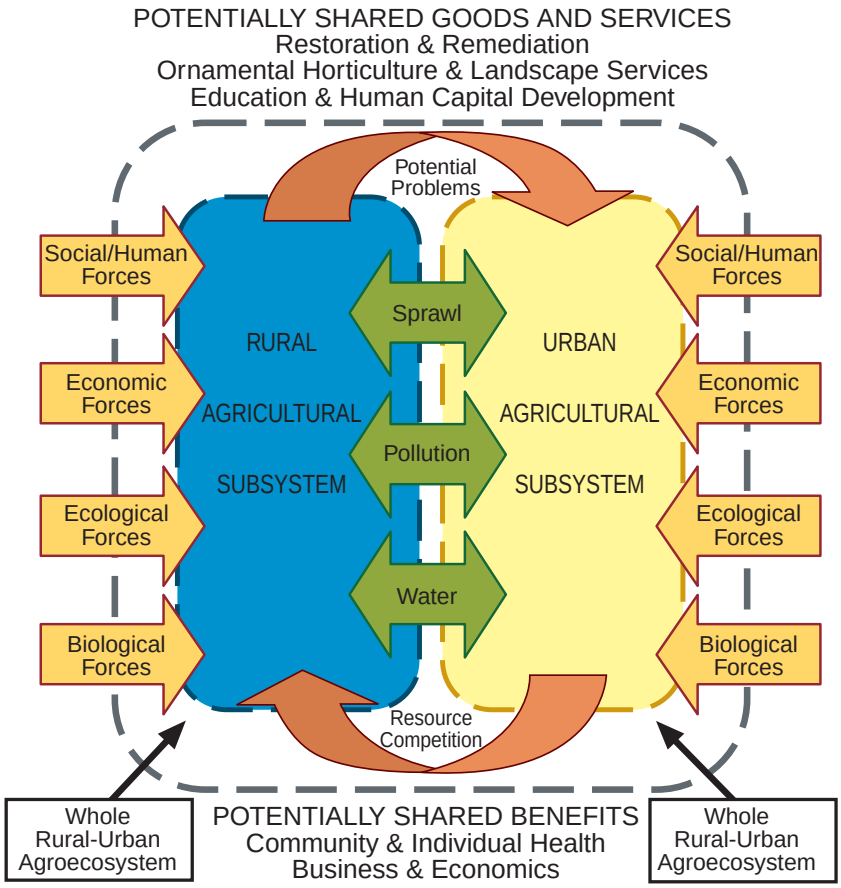

Figure 1.3. The rural-urban agroecosystem encompasses a series of shared problems, goods and services, and benefits. Although the problems are not always common to all urban and rural agricultural communities, the examples show ways that goods and services can be mutually beneficial.

sustainability, natural resource availability and allocation, and livable communities are high on their agendas. As mentioned earlier, agricultural policies have treated *economic development* and *community development* as synonymous, and urban areas as distinct from rural areas. This treatment has, at times, pitted one group against the other. The challenge is to shift the emphasis from fiscally oriented policies to those accentuating community capacity building. Local people must generate their own changes in ways that mobilize local resources, entrepreneurship, innovation, and social cohesion.

Background and Situation

Over the years, many terms have been used to describe rural and urban sectors and their locations: these terms include *metropolitan, urban, urban fringe, suburban, city, rural, countryside*, and *periurban*. This array of terms has led to some confusion about exactly what and whom we are talking about. In this report by the Council for Agricultural Science and Technology (CAST), the background of the terms *urban* and *metropolitan* will be discussed, and subsequently the terms will be used synonymously. Occasionally, the terms *urban edge* and *suburban* will be used. These terms are intended to have a similar meaning.

The first U.S. agricultural census was taken in 1850, during a period of vast territorial expansion and technological improvements in U.S. agriculture (Albrecht and Murdock 1990). In subsequent censuses, the definition of *farm* changed several times yet continued to emphasize production operations involving livestock, poultry, animal specialties, and their products, as well as crops, including fruits, and greenhouse and nursery products.[1] Land did not need to be a single contiguous tract to comprise a farm but did have to be operated as a single economic enterprise, although some exceptions were allowed in the 1950s (USDC 1996). The definition for the 1974 and later

censuses of agriculture referred to a *farm* as any place from which $1,000 or more of agricultural products were sold, or normally would have been sold, during the census year. This more recent definition standardizes the use of the term and provides a rationale for limiting a discussion of agriculture and demographic changes to the last quarter of the twentieth century.

Thus far, the liberal use of the term *urban* misrepresents the conceptual and analytical variation that exists with its application. Social scientists have long debated the distinction between *rural* and *urban* and its relevance for community life (Goodall, Kafadar, and Tukey 1998; Wilkinson 1991). This distinction has competed often, however, with that between *metropolitan area* and *nonmetropolitan area*, terms developed by the Office of Management and Budget (OMB) in 1949.[2] The difficulty with using these concepts is that the empirical measure of urban-rural areas cuts across metropolitan and nonmetropolitan areas, and the data for these areas generally do not correspond, as other government data do, to county lines (Ricketts, Johnson-Webb, and Taylor 1998).[3] Moreover, social scientists have made refinements and provided special definitions such as *rural frontiers* to accommodate specific governmental policy and program objectives (Zelarney and Ciarlo 1999).[4]

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[1]The definition of a *farm* has included several criteria since the 1850 census. From 1785 to 1860, no acreage requirement existed, but a minimum of $100 in sales of agricultural products was required. From 1870 to 1890, the definition included any place of three or more acres involved in agricultural production. Places with fewer than three acres were considered farms if they had a minimum annual value of $500 in agricultural sales. In 1900, there were no acreage or minimum sales criteria. Cranberry marshes, greenhouses, and city dairies were included for the first time in the definition if they required the full-time services of at least one person. The definition from 1910 to 1920 became a minimum of three acres, with $250 or more in total value of sales, unless the individual operation required the full-time services of at least one person. The definition was unchanged, except for the deletion of the requirement of a full-time person, from 1925 to 1945. In 1950 and 1954, a farm included any place of fewer than three acres if it had, or normally would have had, sales of $150 or more in agricultural products during the census year. Places that began operating as farms for the first time in 1954 also were included. Parcels operated by sharecroppers and tenant farms counted as separate farms even though the landlord managed the whole holding as a single unit. Moreover, land retained and operated by the landlord was counted as a separate farm unit. In censuses conducted from 1959 to 1969, the farm definition raised the acreage requirement to 10 acres or more, with at least $50 or more in agricultural sales. A place of fewer than 10 acres qualified as a farm if it had sales of $250 or more during the census year (USDC 1996). The current farm definition for the 50 states differs in areal and sales criteria used in censuses conducted in U.S. protectorates. Also, the United Nation's Food and Agricultural Organization, which collects farm production data internationally, cautions that its indices may differ from those produced by the countries themselves because of differences in definitions of *production*, *coverage*, *weights*, and in concepts of time reference of data and methods of calculation (FAO 1999b). Such differences constrain comparisons of domestic and foreign farm production and other economic indicators.

[2]The U.S. Census Bureau defines *urban* as comprising all territory, population, and housing units in urbanized areas and in (1) places of 2,500 or more persons incorporated as cities, villages, boroughs, and towns (with exclusions in some states); (2) Census Designated Places of 2,500 or more people; and (3) other incorporated or unincorporated territory in urbanized areas. An urbanized area has one or more central places and an adjacent densely settled surrounding territory, or urban fringe, that contains a minimum of 50,000 people (USDC 1991). The *urban fringe* consists generally of territory contiguous to a central place and of at least 1,000 people/mile. Territory, population, and housing units not classified as urban are deemed rural, being places of fewer than 2,500 inhabitants. A *metropolitan area* (MA) is a large-population nucleus of 50,000 or more people in addition to adjacent communities with a high degree of economic and social integration with that nucleus. An MA also can be an urbanized area with a total population of at least 100,000 (75,000 in New England). Residual territories, populations, and housing units located outside an MA are referred to as *nonmetropolitan*. The Census and Office of Management and Budget (OMB) distinguish other, larger units (e.g., consolidated and primary metropolitan statistical areas [MSAs]) based on populations of one million or more.

[3]The World Resources Institute (WRI) stated in a 1996 report that around the world the term *urban area* is synonymous with *city* although the two terms are not the same. *Urban* is a statistical concept that differs in meaning from one country to the next, according to a combination of criteria such as population density, political function, or predominant activity of the region. All cities are urban areas, but the converse is not always true. A city is a complex political, economic, and social center symbolizing, in some sense, its nation's identity. The WRI advises that comparisons of urban and city data can be misleading and that the available data be treated as best estimates.

[4]The Economic Research Service (ERS) produced three other classification schemes. Similar to the Rural-Urban Continuum Codes, the Urban Influence Codes classify a county by size of the cities within it and its proximity to larger metropolitan economies and urban populations (Ghelfi and Parker 1995). This index has two metropolitan and seven nonmetropolitan subclassifications. The ERS also produced a rural county typology in 1979 (with a revision in 1994) that identifies groups of nonmetropolitan counties having similar economical and policy characteristics. Six overlapping classifications are farming-dependent, mining-dependent, manufacturing-dependent, government-dependent, services-dependent, and nonspecialized. Its five overlapping policy types are retirement-destination, federal lands, commuting, persistent poverty, and transfer-dependent (Bender et al. 1985; Cook and Mizer 1994). Finally, the Goldsmith Rural Modification scheme improves the definition of rural areas in metropolitan counties. It identifies areas in large MAs that are small town or open-country with no easy access to central areas (Goldsmith, Puskin, and Stiles 1993). Farmer (1997) summarizes some of the literature behind alternative measures of *rural* and *rurality*.

Table 1.1. Metropolitan status of U.S. counties, 1970 to 1990, by size of population (000s)

	1970 to 1980[a]		1980 to 1987[b]		1980 to 1990[c]	
Status	Counties	Population	Counties	Population	Counties	Population
Metropolitan	651	148,433	739	171,573	834	176,028
All nonmetropolitan	2,458	53,769	2,369	53,560	2,277	49,148
Adjacent	974	27,896	1,081	30,956	1,002	26,901
Nonadjacent	1,484	25,872	1,288	22,602	1,275	22,247
Total	3,109	202,201	3,108	225,133	3,111	225,176
Missing Counties	3		4		0	

[a]Based on 1975 *metropolitan* definition (Johnson 1989).

[b]Based on 1985 *metropolitan* definition (Johnson 1989).

[c]Based on 1993 *metropolitan* definition (Johnson and Beale 1994).

The U.S. Department of Agriculture's (USDA) *National Resources Inventory* definition of *urban and built-up areas* includes those measured by the Bureau of the Census, as well as developed tracts of 10 acres or more (residential, industrial, commercial, and institutional land), and tracts of 0.25 to 10 acres (construction sites, public administration sites, railroad yards, cemeteries, airports, etc.) that do not meet the definition of urban but are surrounded by urban and built-up land. Compared with the Census Bureau's definition of *urban*, the NRI includes more large-lot development and developed land. The NRI's *developed land* includes urban and built-up areas and land devoted to rural transportation (USDA-NRCS 1997c.)

Even the definition of *metropolitan* changed after the introduction of the concept. The ERS placed counties on a rural-to-urban continuum and subdivided OMB's broad metropolitan and nonmetropolitan categories into four metropolitan and six nonmetropolitan subcategories in 1975. The scheme, officially known as the Rural-Urban Continuum Codes, was updated in 1983 and revised slightly in 1988 and again in 1993. The latest revision applied the 1990 census count and defined a *nonmetropolitan* county as a county adjacent to a metropolitan statistical area (MSA) if it had 2% or more of its employed labor force commuting to central metropolitan counties (Butler and Beale 1994). Each change resulted in a reclassification due either to the number of counties categorized as nonmetropolitan being absorbed by growing MAs, or to former nonmetropolitan counties forming entirely new MAs (Johnson 1989). Johnson and Beale (1994) pointed out that the choice of any of the metropolitan definitions for classifying counties is not trivial. For example, they calculated a net shift of 92 counties from the nonmetropolitan to the metropolitan category as a result of using the most recent definition of *metropolitan* instead of a former definition. Table 1.1 shows changes in the distribution of counties according to the definition of *metropolitan* from 1970 to 1990, and according to the size of the population.

The Rural-Urban Continuum Codes are used in this chapter. The codes, their descriptions, and the number of counties in each category appear in Table 1.2, which shows U.S. counties based on the 1993 metropolitan definition. To facilitate comparisons of demographic and agricultural data, the authors of the current study took the nine-category scale and simplified it into three categories: metropolitan (codes 0 to 3; n [number of counties] = 813), adjacent nonmetropolitan (codes 4, 6, and 8; n = 989), and nonadjacent metropolitan (codes 5, 7, and 9; n = 1,299).

Use of these codes has at least two identifiable weaknesses. First, the codes do not reveal rural and urban population areas (as defined by the Census Bureau) that overlap metropolitan and nonmetropolitan counties. In the 1990s, there were 813 metropolitan counties, 989 nonmetropolitan counties adjacent to metropolitan counties, and 1,299 nonadjacent, nonmetropolitan counties. Almost 14% of the metropolitan counties also could be classified as having a mostly rural population, and 37% of the nonmetropolitan counties had a mostly urban population (Ricketts,

[5]Standard definitions of MAs were first used in 1949 by the Bureau of the Budget (the predecessor of the current Office of Management and Budget). These areas were designated *standard metropolitan areas* (SMAs). The term was changed during the early 1980s to *standard metropolitan statistical area* (SMSA). Since 1990, the OMB has used the collective term *metropolitan area* (MA).

Table 1.2. Rural-Urban Continuum Codes, 1993 (Butler and Beale 1994)

Codes	Description	Number of counties
Metropolitan		813
0	Central counties of metropolitan areas of 1 million population or more	167
1	Fringe counties of metropolitan areas of 1 million population or more	132
2	Counties in metropolitan areas of 250,000 to 1,000,000 population	315
3	Counties in metropolitan areas of less than 250,000 population	199
Nonmetropolitan		2,288
4	Urban population of 20,000 or more adjacent to a metropolitan area	133
5	Urban population of 20,000 or more not adjacent to a metropolitan area	113
6	Urban population of 2,500 to19,999 adjacent to a metropolitan area	608
7	Urban population of 2,500 to 19,999 not adjacent to a metropolitan area	654
8	Completely rural (no places with a population of 2,500 or more) adjacent to a metropolitan area	248
9	Completely rural (no places with a population of 2,500 or more) not adjacent to a metropolitan area	532
Total number of counties		3,101

Johnson-Webb, and Taylor 1998). These seemingly inconsistent definitions of counties are part of the vagaries of the current Metropolitan Statistical Area definition system.[5] The second weakness is that the nonmetropolitan status of a county might have changed from classifications in previous years to metropolitan status in 1993 with the growth of metropolitan centers and the urban fringe. For instance, a nonmetropolitan county in 1978 might have changed to be a metropolitan county by 1993 but, with a constant 1993 MSA definition, it would seem to have been "metropolitan" all along. Consequently, use of classification status in 1993 with past agricultural data may overstate the importance of metropolitan counties and understate the influence of nonmetropolitan counties to agricultural production in the United States.

Improvements in farming techniques and an expanding railroad network helped the farm population and the agriculture industry expand greatly during the nineteenth century and into the twentieth century (Albrecht and Murdock 1990). When the farm population first was enumerated apart from the general population in 1880, it included 21.9 million people, about 44% of the total U.S. population (Appendix A, Table A.1). At the turn of the century, the number had increased to 29.8 million but was a smaller percentage (41.9%) of an increasingly urban and industrializing population. Although stable from 1910 to 1940, the size of the farm population continued to become a proportionately smaller part of society. By 1959, it had decreased to 16.6 million and to less than 10% of the total U.S. population. Both the farm population and its proportion of the total population declined during subsequent decades, as agricultural competition and costs increased. In 1991, the farm population was 4.6 million, or about 1.8% of the total U.S. population.

Corresponding changes are shown in Appendix A, Table A.2 for number of farms, acres of farmland, percentage of land in farms, and average size of farms from 1850 to 1997. The 1850 *Census of Agriculture* revealed that nearly 1.5 million farms existed in the United States and accounted for 294 million acres (a.), or 15.6% of the national landmass at that time. The average farm size was 203 a. in 1850. From the late 1880s to 1950s, acreage in production and percentage of land in farms gradually increased with farm population size. The average size farm declined to 134 a. in 1880, but subsequently has increased. Beginning in 1950, the number of farms declined as both farm acreage and size increased. Farm acreage, which had reached a high of 1.2 billion in 1950, began to decline afterwards with the percentage of land in farms. Much of this decline occurred as a result of the farm crises during the 1980s (Murdock and Leistritz 1988); changes in U.S. farm policy (Flora 1990; Spitze and Flinchbaugh 1994); urban development; and increased concentration among large corporate farms, whose economies of scale, ability to benefit from farm policy, and productivity rates exceeded those of smaller farms (Guither, Baumes, and Meyers 1994; Paarlberg 1980). Changes in the farm definition notwithstanding, the average farm size of 487 a. in 1997 was more than triple that in 1900 and more than double that in 1950. According to USDA's revised *National Resources Inventory* (USDA-NRCS 2000b Table 8) the total amount of agricultural land (crop, pasture, range, and conservation reserve program) converted to developed uses between 1992 and 1997 totaled approximately 6 million a., which translates to an av-

erage annual rate of 1.2 million acres. The average annual rate of conversion is 2.3 million acres.

Recent U.S. Demographic Changes

Near the end of the twentieth century, the U.S. population of 272 million was approximately 3.5 times larger than it was one hundred years before (USBC 1998). According to Johnson (1993), most of the past century was dominated by two demographic trends. First, the natural increase of the U.S. population accounted for nearly all growth in the nonmetropolitan population. Second, the number of people leaving nonmetropolitan areas greatly exceeded the number entering those areas. Although the magnitude of in- and out-migration depended upon decade and region, flow of migration was generally from nonmetropolitan to metropolitan counties. Metropolitan areas in the United States continued to grow in spite of the more recent movement of population from metropolitan to nonmetropolitan areas in the 1970s to 1990s (Johnson 1989).

The recent percentage change in population among metropolitan and nonmetropolitan counties is shown in Table 1.3. These are averages of all counties within each category. Individual counties differ widely. In 1980, U.S. resident population was 226 million. During the 1980s, metropolitan counties experienced the greatest percentage increase (14.5%) in population; counties adjacent to metropolitan counties averaged a slight increase (3.8%), as nonadjacent, nonmetropolitan counties averaged a 1.6% loss in population. Although all categories of counties had natural increases (by birth) in terms of size of population, both adjacent and nonadjacent, nonmetropolitan counties suffered out-migration of residents. This loss pattern reversed itself during the 1990s, however. Population increases occurred for metropolitan and nonmetropolitan counties as a result of both natural increases and net migration gains.

Researchers have studied these recent changes in the U.S. population intensively, with special emphasis on the growth of minority populations (Murdock 1995). A brief examination of the ethnic and racial composition of population changes and the average percentages of change over the past two decades are presented for metropolitan and nonmetropolitan counties in Appendix A, Tables A.3 and A.4, respectively. The ethnic and racial groups are Anglo-Americans (nonHispanic whites), nonHispanic blacks, other nonHispanic groups, and Hispanics. Ethnic group data from the 2000 census are not reported in the tables because changes in how these groups are defined in 2000 affect comparisons with the data from previous census periods. Slight increases in population occurred from 1980 to 1990 in all groups, except for Anglo-Americans residing in nonadjacent, nonmetropolitan counties. Regardless of county of residence, all four ethnic/racial groups increased in size during the 1990s. The greatest proportional increases oc-

Table 1.3. Components of county population change, 1980 to 1998, by metropolitan proximity in 1993[a]

		1980 to 1990			1990 to 1998		
County metro proximity, 1993		Percentage, population change	Percentage, natural increase[b]	Percentage, net migration	Percentage, population change	Percentage, natural increase[b]	Percentage, net migration
Metro	Mean	14.5	7.7	6.8	12.8	5.4	7.4
	Median	9.4	7.2	2.0	9.6	5.0	4.2
	Number	836	836	836	836	836	836
Adjacent to metro	Mean	3.8	4.8	–1.0	8.3	2.3	6.0
	Median	1.4	4.2	–3.4	5.9	2.2	3.9
	Number	1,001	1,001	1,000	1,000	1,000	1,000
Not adjacent to metro	Mean	–1.6	5.2	–6.8	4.0	1.8	2.2
	Median	–3.8	4.1	–8.1	2.6	1.3	0.6
	Number	1,302	1,302	1,301	1,301	1,301	1,301
Total	Mean	4.4	5.7	–1.3	7.7	2.9	4.8
	Median	1.4	5.0	–4.1	5.5	2.6	2.5
	Number	3,139	3,139	3,137	3,137	3,137	3,137

[a]Source: U.S. Bureau of the Census and authors' computations.

[b]*Natural increase* is the result of the number of births minus the number of deaths.

curred among Hispanics, nonHispanic blacks, and other ethnic and racial groups. Hispanics nearly tripled their sizes of population in metropolitan counties from 1980 to 1999 and evidenced the greatest percentage change during the 1980s and 1990s (Appendix A, Table A.3). Although the largest segment of the U.S. population, Anglo-Americans evidenced by far the smallest percentage of change in each decade.

Today's Rural-Urban Agriculture

As has been mentioned, the general public perceives agriculture as a rural enterprise in which work, residence, and family life are intertwined and underpinned by traditional agrarian beliefs (Molnar and Wu 1989). Looking at agriculture through metropolitan and nonmetropolitan county lenses indicates that the public belief about where farming occurs may be a misconception. Employment in the broader agriculture, forestry, horticulture, and fisheries industry (called the *agriculture industry* hereafter) is reported by county category in Appendix A, Table A.5 for the period 1980 to 1997. In 1980, 3.9 million people were working in the agricultural industry. Metropolitan counties accounted for 47% of the agriculture industry's total employment, compared with 25 and 28% by adjacent and nonadjacent, nonmetropolitan counties, respectively. The agricultural industry's proportion of employed persons to total industrial employment in metropolitan counties was 2.4% and 1.9% for the United States in 1980. By comparison, the agriculture industry's proportion of employed persons to total employment in adjacent and nonadjacent, nonmetropolitan counties was 9.2 and 12.8%, respectively. Nationally, the industry was responsible for 1.0 and 1.1% of all U.S. industrial employment in adjacent and nonadjacent, nonmetropolitan counties, respectively. By 1997, metropolitan counties accounted for more than half (54%) of all agricultural employment relative to nonmetropolitan counties.

In 1980, approximately 2.8 million people were employed in agricultural occupations (Appendix A, Table A.6). This number was estimated to have increased to about 3 million by 1997. Metropolitan counties provided the largest proportion of agricultural jobs, accounting for 46% in 1980, 53% in 1990, and 54% in 1997. The number of people employed in agricultural occupations declined slightly since 1980 in nonmetropolitan counties and was divided almost evenly between counties adjacent and those nonadjacent to metropolitan counties.

Examination of several selected economic characteristics indicates the spatial arrangement of U.S. farming (Heaton 1980). Mean and median numbers of farms appear in Appendix A, Table A.7. Metropolitan counties have had the greatest average and median numbers of farms since 1978. Nonadjacent, nonmetropolitan counties have had the fewest number of farms over the 20-year (yr) period. Metropolitan counties averaged 889 farms in 1978; adjacent and nonadjacent counties averaged 787 and 608 farms, respectively. By the end of the 1990s, the average number of farms had declined to 772 in metropolitan counties, 650 farms in adjacent counties, and 507 in nonadjacent counties.

The proportion of acres in farmland compared with the total county land area (Appendix A, Table A.8) and average farm size (Appendix A, Table A.9) indicate the degree to which farming dominates county landscapes (USBC, various years 1978-1992; USDA-NASS 1997a). Two patterns exist. The average share of farmland compared with the total land area has declined, and nonmetropolitan counties consistently have had the largest proportions of their acreage in farms. Metropolitan counties have averaged nearly 4 of every 10 a. in farmland during the 1980s and 1990s.

The mean farm size increased slightly from 449 to 487 a. nationally (Appendix A, Table A.9). Nonadjacent, nonmetropolitan counties had the largest farms on average, and metropolitan counties had the smallest farms. Changes in average farm size parallel the pattern of overall increase in farm acreage. Median acreage for average farm size/county increased from 266 a. in 1978 to 285 a. in 1997. These increases occurred in nonmetropolitan counties, especially in nonadjacent counties.

Economic production similarities and differences in the spatial location of farms are indicated by comparisons of gross farm sales (Appendix A, Tables A.10 to A.12). Average gross farm sales/county increased overall from $47 million in 1978 to $103 million in 1997, and the change in median value of average gross sales/county doubled from $36 million to $72 million. Metropolitan and nonadjacent,[6] nonmetropolitan counties averaged the most gross farm sales for each

[6]For Appendix A, Tables A.11 and A.12, county-level data were used. These data have suppressed values for some counties (and two states). In sums across counties within each proximity group (i.e., metropolitan, adjoining nonmetropolitan, and nonadjoining nonmetropolitan), these suppressed values were not included. In the national aggregated gross sales data reported by commodity these values are included by the U.S. Census and/or the USDA statistics, thus producing larger gross sales figures than the CAST task force authors obtained.

agricultural census period when compared with adjacent, nonmetropolitan counties. In 1997, metropolitan and nonadjacent, nonmetropolitan counties averaged $108 million and $112 million in gross farm sales, respectively, compared with $89 million by adjacent, nonmetropolitan counties (Appendix A, Table A.10).

Total crop sales (unadjusted dollars) between 1978 and 1997 more than doubled from $47.3 billion in 1978 to $96 billion. Grain sales increased from $26.7 billion (1978) to $46.5 billion (1997), followed by gains for fruits/nuts/berries (from $4.5 billion to $12.5 billion), nursery/greenhouse products (from $2.5 billion to $10.1 billion), and vegetables/sweet corn/melons (from $3.2 billion to $8.2 billion). Increases also occurred for cotton/cotton seed (from $3.1 billion to $5.9 billion), other crops (from $2.9 billion to $5.5 billion), hay/silage/field seeds (from $2.2 billion to $4.4 billion), and tobacco (from $2.3 billion to $2.9 billion) (Appendix A, Table A.11).

In 1978, metropolitan counties accounted for 38.9% of the total value of crop sales while adjacent and nonadjacent, nonmetropolitan counties accounted for 28.7 and 24.1%, respectively. By 1997, the share of metropolitan counties had increased to 42.2% of total crop sales compared with the 26.6% share of adjacent, nonmetropolitan counties and the 31.2% share of nonadjacent, nonmetropolitan counties. This gain in metropolitan crop sales could be attributed to assigning 1993 metropolitan status to include counties that may not have been metropolitan in 1978 or in the following year. Nevertheless, metropolitan counties led other counties in total crop sales for fruits/nuts/berries, nursery/greenhouse, and vegetables/sweet corn/melons in the past five censuses. They led in sales for hay/silage/field seeds in all census years except 1978, and for cotton/cottonseed in all census years except 1997. Adjacent nonmetropolitan counties led in tobacco sales, and nonadjacent counties consistently led in grain and other crop sales and in cotton/cottonseed sales in 1997.

Between 1978 and 1997, total livestock/poultry sales (unadjusted dollars) increased from $57.2 billion to $94.4 billion (Appendix A, Table A.12).[7] Sales of livestock/poultry were greater than gross crop sales in every census year, except in 1997. Cattle/calf sales increased from $29.4 billion to $40 billion. Poultry product sales increased the most, 155% (from $7.9 to $20.3 billion). They were followed by sales growth in dairy products (from $10.9 billion to $18.6 billion), hogs/pigs (from $7.6 billion to $12.9 billion), and other livestock products (from $0.7 billion to $2 billion). Gross sales of sheep/lambs/wool were well under a billion dollars during the same period.

Metropolitan counties accounted for 28.7% of the total value of livestock and poultry sales in 1978, while adjacent and nonadjacent, nonmetropolitan counties accounted for 31.3 and 40%, respectively. By 1997, metropolitan counties' share had declined slightly to 26% of total livestock and poultry sales, compared with slight increases to 32.2% by adjacent, nonmetropolitan counties and 41.8% by nonadjacent, nonmetropolitan counties. Metropolitan counties led other counties in total sales for dairy products and other livestock in the past five censuses. They also led in poultry product sales from 1987 to 1997 whereas adjacent, nonmetropolitan counties led in these sales prior to 1987. Nonadjacent counties led in the gross sales of cattle/calves, hogs/pigs, and sheep/lambs/wool from 1978 to 1997.

Myths, Stereotypes, and Realities

Rural and urban cultures tend to be separate in the minds of U.S. residents. Treatment of the needs of cities and of farming communities must be reassessed. Myths and stereotypes hinder the envisioning of future possibilities for agriculture's role in addressing the needs of rural and urban areas.

The belief that city life, centered on manufacturing and commerce, and rural life, centered on farming, produce radically different kinds of life experience (and corresponding moral character) is ingrained deeply in U.S. political culture. The belief dates back to Jefferson, who wrote, "Those who labour in the earth are the chosen people of God, if ever he had a chosen people, in whose breasts he has made his peculiar deposit for substantial and genuine virtue" (1984, 290). Such praise of farming often is repeated in U.S. politics. According to Lincoln, "No other human occupation opens so wide a field for the profitable and agreeable combination of labor with thought, as agriculture" (Ayres 1992, 4). More than a century after Jefferson, Theodore Roosevelt wrote that "the permanent greatness of any State must ultimately depend more upon the character of its country population than anything else" (McGovern 1967, 28). In the 1950s, Ezra Taft Benson, an official of the Eisenhower administration, repeated the theme: "Rural people are a bulwark against all that is aimed at weakening and destroying our American way of life" (McGovern 1967, 428).

[7]For Appendix A, Tables A.11 and A.12, county-level data were used. See comments in previous footnote.

Perhaps some of these quotes praising the moral character of rural U.S. citizens reflect the cynicism of politicians pandering for votes; nonetheless, concepts are rooted in a political reality that framed key political decisions for several hundred years. Jefferson's praise of farming reflected a key difference between him and his main political rival, Alexander Hamilton. Hamilton represented advocates of the urban way of life. He advocated a federal program to promote development of a manufacturing center that would become the central engine of economic growth for the new republic. Jefferson advocated policies such as the Louisiana Purchase and the Lewis and Clark Expedition, which would open new lands for farming and orient the economic development of the young nation towards agriculture.

Hamilton and Jefferson also espoused contrasting philosophies of government that coincided with their visions of economic growth. Both feared the influence of the urban working class, which they believed lacked the discipline and the loyalty necessary to undertake the sacrifices needed for long-term economic growth and development of stable political institutions. Hamilton thought that the power of the federal government should be limited sharply and controlled narrowly by elite families, including industrialists. Jefferson believed the owners of industrial capital were as likely to abandon the new republic as were their workers. He believed that power could be shared broadly in an agricultural nation because farmers were dependent on responsible and stable governments to protect their primary asset, that is, land. Unlike laborers and manufacturers, farmers' long-term economic interests coincided with the development of stable democratic institutions of governance (Thompson 2000).

Contemporary reality is far more complex than myths and stereotypes associating either urban or rural environments and people with certain lifestyles, values, and moral characteristics. It is difficult to document the accuracy or origins of myths handed down from generation to generation and to identify their usefulness today. Positive stereotypes, on the one hand, may be empowering, although not always; negative stereotypes can be quite the opposite, of course. The demarcation between urban and rural agriculture now may exist more profoundly in the mind than on the land. In many parts of the United States, urban centers blend into suburbs, which in turn blend seamlessly into a countryside where farms and bedroom communities exist side by side. These quasisuburban, quasifarming neighborhoods contribute greatly to urban quality of life. Even within urban centers, various parks, gardens, and recreational areas such as golf courses have brought a bit of the countryside into the urban core. As agriculture becomes more industrialized, demand for manufactured inputs, which are produced primarily in urban areas, increases. Scientific and governmental services supporting farming now are needed to support the rural enclave within the urban landscape. These changes encourage urban and rural cooperation.

The Scope of Urban Agriculture

Except in the central Great Plains, a great deal of U.S. agriculture occurs in counties defined as *urban influenced* (within statistical metropolitan counties or adjacent counties). These areas contain much of the nation's most productive agriculture and grow most of the food eaten. In fact, 79% of U.S. fruit, 68% of vegetables, and 52% of dairy products are produced in urban-influenced counties (Sorenson, Greene, and Russ 1997). The public perception of agriculture is crucial because it drives the policies crafted around urbanism and the role that food and agriculture play in urban settings. If much of U.S. agriculture is, in fact, occurring in urban and suburban areas, then it is imperative to foster a relationship between urban and rural policymakers. Yet many people living in rural and urban areas do not recognize the value of agriculture to their daily lives.

Beyond food production, well-managed agriculture provides a host of nonmarket benefits such as attractive landscapes, scenic views, and cultural continuity, as well as ecological services such as composting, carbon sequestration, remediation, wildlife habitat, and clean water. These benefits lead to recreational opportunities that help sustain a rural way of life even in an urban context.

All people benefit from agriculture, which is in the fabric of the urban community. Although it is not the only component, agriculture can be a valuable contributor to the solution of current and future problems occurring in urbanizing communities. Some applications of agriculture are more direct, such as improvement of water and soil quality, production and marketing of food, and control of undesirable insects. Likewise, applications exist whereby agriculture's benefits are more indirect, such as the conservation and management of open space, which, if done sustainably, affords the population the opportunity to enjoy recreational pursuits, biodiverse plant life, and other quality-of-life amenities. Agriculture is a tool with many valuable parts that can be harnessed or

combined with other human or scientific resources, to serve societal needs. These direct and indirect contributions have unique applications in urban settings, where population and land use is more concentrated and public debate over how to resolve urban problems is more heated.

Urban agriculture means different things to different people. In the broadest sense, it covers a sphere of social, ecological, and economic influences throughout a total metropolitan population and land area, including surrounding communities closely connected to the system. Depending on the location, it can include horticulture, aquaculture, forestry, animals such as livestock and exotic species, insect rearing (e.g., beneficial insects) and management, traditional food production, and food and plant gathering. Other components include processing, landscape and other services, agribusiness and value-added activities, recreation and leisure, conservation and revitalization of natural resources, and community health. Urban agriculture is intertwined with the larger agricultural system, much of which is found in nonmetropolitan areas. These connections are fostered by infrastructure such as transportation systems (highways, airlines), computer technology, social networks, and currency exchange and investments.

2 Agriculture's Service Role in the Urbanizing Society

Introduction

Understanding the agroecosystem functions and maintaining biodiversity within the system are essential to maximizing system benefits. Many agricultural activities (e.g., animal and plant production and preservation, creation of urban planted landscapes, reforestation of open spaces) can affect a highly interdependent agroecosystem. Consequently, agricultural activities can help to replenish and to sustain agroecosystems and, in turn, subsequent agroecosystem services benefiting urban populations.

When well planned and properly integrated into the urban environment, open space or natural areas (as opposed to built-up areas) provide valuable agroecosystem services to the surrounding community. Critical agroecosystem processes emanating from nature are fundamental to the life support system on earth. Open spaces afford alternatives for water management by serving as receptacles for storm water, recharge areas for aquifers, filtration systems for surface waters, and storage sites for irrigation water. *Water reuse* (reclamation, or "gray water") from waste treatment facilities is used to sustain recreational areas and to irrigate nonfood crops. Composting activities result in decreasing solid wastes from populated areas and are a source of nutrients and organic matter for urban landscapes and for rehabilitation of *disturbed lands* (e.g., mine sites, highway right-of-ways, vacant lots). Properly managed, urban green areas can serve as wildlife habitats. Appropriate land management and design practices rooted in the agricultural sciences are essential in applications of land-use planning, pollution abatement, site remediation, and carbon sequestration processes. When exploited properly through careful planning, ecosystem services have measurable economic value (Costanza et al. 1997); their positive effects on quality of life are difficult to quantify, however.

Selected examples of agroecosystem services for which the agricultural sciences can contribute knowledge and expertise include storm water management, waste-water remediation, waste recycling (e.g., composting), phytoremediation, carbon sequestration, soil retention and fertility, proper pesticide and fertilizer use, and remediation of brownfields. While recognizing that some services require further research if their applicability to urbanization is to be perfected, the authors of this CAST report contend that such services are a valuable part of the rural-urban agricultural system.

A host of agricultural services, including water conservation, pollution control, and environmental risk mitigation, are funded wholly or in part through federal agency budgets and supported by research and educational programs at agricultural and other universities. Although these services may not be perceived as a form of urban agriculture, each represents a benefit provided to urban and rural residents under an organizational and budgetary rubric of agriculture. Neglect of agriculture could mean, therefore, neglect of the infrastructure supporting these vital agroecosystem services. Both rural and urban residents and their legislative representatives will benefit from becoming better informed about how they can draw on agriculture to ensure the availability of such vital services and functions. The increased need for agricultural services in MAs, coupled with the continuing demands from traditional agricultural constituents, taxes current institutional systems. This makes it even more important for urban leaders to interact with agricultural leaders and scientists to share knowledge, resources, and innovative ideas for addressing crucial urban insect and wildlife issues.

Agroecosystem Services for Restoration and Remediation

Storm Water Management

Agricultural engineering and land management practices offer scientifically proven methods by which to prevent the destruction of environmentally sensitive areas as a result of storm water runoff. Removal of vegetation and placement of impervious surfaces and structures often change surface and subsurface water flow and groundwater recharge. Accelerated

water flow can create erosion, pollution, and sediment management problems. *Storm water management* refers to comprehensive strategies for dealing with storm water quantity and quality issues. To achieve management goals, a cost-effective combination of structural and nonstructural techniques must be used to ensure adequate pollutant (e.g., oil, grease, pesticides, fertilizers) removal, erosion control, and flood protection. The principle strategy is to ensure that the volume, rate, timing, and pollutant load of runoff after development is similar to that before. Structural techniques require preservation or simulation of natural drainage features to promote infiltration, filtering, and slowing of runoff (EPA 1999; NRDC 1999).

In a natural setting, vegetation and plant debris restricts water flow, extends water infiltration time, and holds soil in place. Vegetation and its supporting soil microflora also absorb pollutants and/or mitigate toxicity (Wood 2000). Plants with large root-systems create storage passageways that can facilitate water storage in the soil. Trees with high transpiration rates pump stored water from the soil into the atmosphere. Thus, barren land yields more runoff than forested land. Failure to maintain vegetative cover can restrict aquifer recharge. Aquifers often serve as sources of clean water for communities. Strategically placed vegetation strips can serve as effective sedimentation/filtration systems (Schultz et al. 1995). Often, storm water runoff flows directly into lakes and streams.

Many LGUs work closely with state highway departments to develop effective sedimentation and filtration systems for control of vegetation and water runoff. Vegetative controls on highway medians can be as effective as sedimentation/filtration systems for treating storm water runoff and can be more economical than manufactured structures. Future planning of urban roadways and open spaces should include appropriate storm water management practices drawing on natural or vegetative solutions. Agricultural scientists can provide recommendations about varietal selection and performance to minimize erosion, to maintain sight lines, and to add aesthetic appeal.

Water Remediation and Wastewater Reclamation

The same principles that apply to control of water runoff from agricultural land apply to urban situations, and vice versa. Both urban planners and agricultural scientists have expertise that needs to be shared to facilitate development of a comprehensive water remediation and reclamation strategy. This is clearly a common problem faced by agricultural and by nonagricultural communities. Both face problems such as pesticide and nutrient runoff, groundwater contamination, waste disposal (farm animal and human waste), soil erosion, aquifer reduction, and the growing need for clean water. Technical solutions and water-related legislation with direct applicability to both parties exist currently.

Over the last two decades, there has been a steady increase in the use of natural, physical, biological, and chemical aquatic processes to treat polluted water. This increase has been precipitated by scientific documentation of the natural treatment functions of wetlands and aquatic plants (Figure 2.1). The escalating costs of conventional treatment methods, and the value-added benefits of these systems, have heightened interest in their use (NCSU 2001b).

Figure 2.1. Wetland and streamside vegetation serves as a buffer to filter excess nutrients from water running off agricultural land. Photo by Scott Bauer, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Maryland.

Aquatic treatments include natural wetlands, constructed wetlands, and aquatic plant systems (EPA 1988). *Constructed wetlands* are created wetlands designed and developed for water treatment (Fields 1993). They are engineered systems designed to simulate natural wetlands that function to purify water for human use and benefit. Constructed wetlands are modified to restrict drainage and to stimulate growth of flora and fauna to remove contaminants or pollutants from wastewaters or runoff (Hammer 1992).

Strategically located constructed wetlands are not intended to mimic the functions of natural wetlands. The advantage of constructed wetlands over natural wetlands is that of control over location, design, and management to optimize remediation effects. Constructed wetlands can be positioned to minimize entry into streams, natural wetlands, and other receiving waterways. Wetlands created for habitat, water quantity, or aesthetic and other functions typically require different design considerations than those used solely for water quality improvement.

Constructed wetlands are becoming an increasingly common method for treatment of all forms of water pollution, including confined-animal wastewater, cropland runoff, urban storm water, septic tank effluent, municipal wastewater effluent, acid mine drainage, industrial process waters, and landfill leachate (Bastian and Hammer 1993; Kadlec 1995; Kadlec and Knight 1996). Besides primary wastewater uses, the range of potential applications for constructed wetlands is great, and the record of actual applications is growing. Urban planners and engineers need to give consideration to the development of wetlands during their comprehensive planning process, which provides an ideal opportunity for agricultural scientists to make their information and research findings available for use by urban planners.

Reclaimed and reused wastewater can be a valuable resource in lieu of the diminishing supply of potable water. Research is needed, however, to determine how to control accumulation of salts in soil. High salt content in soil can decrease production capacity. Likewise, acquisition of potable water requires an expenditure of energy in resources. Use of reclaimed water offers cost savings and preserves the diminishing potable water supply. Reclaimed water can be used in nonfood crop irrigation, recreation, and sustaining of vegetation in greenbelt areas. Collaboration among planners, policymakers, and agricultural scientists is essential for the future of water remediation and reuse, which constitute a relatively holistic approach to meeting common needs in an efficient and practical manner.

There are numerous examples of county and municipal legislations that encourage reclamation and reuse of wastewater. A specific example comes from the Sanitation Districts of Los Angeles County, which serves all or a portion of 78 of the 88 cities in the County of Los Angeles. The system includes approximately 1,300 miles of trunk sewers that convey to 11 wastewater treatment plants. Seventeen districts work together to operate sewers, pumping plants, treatment plants, and other sewerage facilities. For example, the Pomona water reclamation plant provides treatment for 13 million gallons (gal.) of wastewater/day, for approximately 130,000 people. Each day, approximately 8 million gal. of purified water is reused at more than 90 different sites. These sites include irrigated parks, schools, golf courses, landscapes, and greenbelts; the Spadra Landfill, which is irrigated and controlled for dust; and local paper manufacturers. The remainder of the water is put back into the San Jose Creek channel, where it makes its way to the unlined portion of the San Gabriel River. Nearly 100% of water is reused because most river water percolates into the groundwater (Sanitation Districts 2001).

The farm also can be a secondary waste treatment system for municipal wastewater. A large number of such systems exist in Ohio, Michigan, and other states in the Midwest, where farmland is relatively plentiful. Forty-two such systems, dating back to 1970, are operating in Ohio, with most constructed in the 1990s. Some are municipal systems, several others treat the waste from a restaurant/club house by irrigating the golf course. In municipal or township systems, a farmer will contract with the city to receive a certain volume of wastewater on a certain schedule. New waste treatment "package systems" rely on farmland and other open lands as the primary treatment technology, thus enabling new residential and commercial development in areas inaccessible to central treatment systems. Although reasonable questions must be addressed about whether to permit such new development in rural areas away from urban centers, farmland is performing an important service for urban people.

Living Machines have been under development since the mid-1980s (Figure 2.2). This technology claims to convert high-strength industrial wastewater into a water supply suitable for most home needs. A diverse constructed ecosystem of plants, bacteria, snails, fish, and other organisms go about the usual business of living and growing, cleaning water at the same time. Users of these systems may save money by bypassing sewer surcharges and the capital costs

of conventional systems. Living Machines also consume the sludge residual of waste treatment (Living Machines, Inc. 2001). Natural systems, including farms, have enormous potential for helping resolve the waste management problems of urban society.

Waste Recycling

Continued research is needed to develop cost-effective ways to recycle waste. Recycling can be a way to replenish diminishing resources such as energy, organic matter, and nutrients. Certain farmers use their land to compost leaves and organic waste from municipalities situated in nearby communities. They combine these external sources with manure and other sources from their farms to create a significant business enterprise while solving a waste management problem for nearby cities or towns. Composted products may be packaged for purchase by home gardeners or turf managers, or for sale in retail outlets (Figure 2.3). Farmland provides the important agroecological service of converting organic material into nutrients. Organic waste decomposes, providing fertilizer for new plant growth while eliminating unwanted waste product.

Fresh Aire Farms, a 250-a. farm near Dayton, Ohio, produces a variety of agronomic and horticultural crops. Having implemented a composting program to decrease the amount of chemical inputs it had to buy, the farm now sells compost to urban customers for $\$45/yd^3$, plus delivery cost. The composting part of the farm produces 25% of its total revenue (Goldstein 1999). A composting enterprise such as this can be an important point of contact between farms and urban people.

Carlyle Consulting in Malibu, California, collects recyclables from urbanites, processes them slightly, and sells the nutrient source to farmers hoping to improve the quality of their soil. In this instance, the urban homeowner is employing the composting service of farmland directly (Gray 1998).

The poultry megafarm Perdue Farms, Inc. of Salisbury, Maryland, produces 800,000 tons (t) of poultry litter annually on 2,800 individual farms in the area. The excess nutrient, instead of being allowed to pollute Chesapeake Bay, is turned into marketable products, such as fertilizer pellets, through a business arrangement with Missouri-based AgriRecycle, Inc. Tyson Foods is exploring the potential for converting poultry litter into an energy source. Farmers are paid for the litter they provide (ENN 2001). Lancaster County, Pennsylvania, has several manure brokers who bring producers and users together for mutual support (Glenn 1998).

Compost helps reclaim soils damaged by strip mining in Ohio and West Virginia. Acid mine soils mixed with manure and drywall waste regain their productivity (Munn and Murray 1999). In New York State, attention has been given to composting food scraps. Statewide, there are more than 230 composting facilities that handle everything from lawn waste to food scraps from households, prisons, food markets, restaurants, or hospitals. Assistance is available to farmers interested in creating a composting operation (CWMI 1999). The economic viability of municipal waste recycling remains in question. Because of the

Figure 2.2. A view into the South Burlington Living Machine Wastewater Treatment System in Vermont. Many economically viable plants can be produced in these systems including cut flowers, landscape plants, and even food for humans and animals. Photo courtesy of Living Machines Inc., Taos, New Mexico.

Figure 2.3. A Suwanee County, Florida, poultry farmer adds water to compost to keep the bacteria working that ultimately turn chicken waste into usable topsoil. Photo by Larry Rana, U.S. Department of Agriculture.

cost of separate collection services and the difficulty of establishing reliable market outlets, many municipalities must struggle to make composting programs viable.

Carbon Sequestration

A new entrepreneurial opportunity exists for agriculture to work with industries and communities that generate significant carbon dioxide (CO_2) emissions. Sequestering carbon can be a beneficial strategy for agriculture, MAs, and the environment. Municipalities generate significant CO_2 emissions through energy generation and burning of fossil fuels. Carbon farming offers an opportunity for farmers to work closely with municipalities to help mitigate CO_2 atmospheric concentrations through planned carbon sequestration practices. Estimates indicate that the potential for a carbon market for U.S. agriculture could reach $5 billion/yr for the next 30 to 40 yr (Consortium 2001).

The *carbon cycle*, one of the central processes in the ecosystem, transfers carbon between organisms, soils, and the atmosphere. Most living matter is water; what remains is composed mainly of carbon-based molecules, especially compounds used in energy transfer and storage. Stored energy is released when carbon compounds are oxidized to CO_2 by means of metabolic reactions. Carbon dioxide from the atmosphere is recycled into more complex carbon compounds by plants and other autotrophic (self-feeding) life forms. Some carbon is recycled immediately; some is stored in ocean sediments, soils, and plant biomass. Plants, for example, store significant amounts of carbon. Subsequently, planting a range of crops (e.g., forest, horticulture, agronomic) absorbs and stores atmospheric carbon.

As a result of population growth and associated human activities, atmospheric CO_2 has increased greatly, from 260 parts per million (ppm) to > 370 ppm since the 1800s (Lal, Kimble, and Follett 1997). As a result of power generation and fossil fuel emissions, nearly six billion t/yr of carbon is released into the world's atmosphere. Approximately 100 billion t/yr is released naturally (FAO 2001). Continued disruption of natural carbon sinks (e.g., forests and other vegetated areas) will decrease the ability of CO_2 to be recycled and fixed as biomass (sequestered) from the atmosphere. *Atmospheric carbon dioxide* is a greenhouse gas crucial to maintaining a heat balance on earth. As concentrations increase, planet temperatures can increase. *Carbon sequestration* (removal of CO_2) mitigates global temperature change and improves soil quality. Conservation and vegetation management practices that preserve rural and urban forests and green spaces not only aid in the sequestration process but also enhance water quality by decreasing water runoff and nonpoint source pollution and providing wildlife habitat.

Measuring carbon storage is difficult. Research is needed to clarify the working of the carbon cycle and to determine how soil and plants contribute to it. For example, how much biomass is needed to sustain a CO_2 balance? What cropping systems and plant varieties offer the greatest potential to fix carbon? What role do soils play in the *carbon cycling process* (e.g., what are the roles of soil respiration and structure, contributions from roots and microorganisms, and the rates of carbon transfer between active and resistant fractions of stored carbon [Lal, Kimble, and Follett 1997])? Although debate continues as to whether urban environments can affect global carbon recycling, research has yet to demonstrate whether there is a potential for this if a collective carbon recycling process was adopted by many urban centers. Farmers can benefit by selling crops that sequester carbon or other crop byproducts (e.g., ethanol, methane) to utility companies as a source of fuel. Through appropriate agricultural research, an opportunity exists to achieve a more harmonious balance between use of and sequestration of carbon.

Remediation of Brownfields

Agriculture is well positioned to provide assistance in remediation of brownfields. *Brownfields* are abandoned, idled, or under-used industrial or commercial sites in which real or perceived environmental contamination occurs. The EPA (2000) estimated that there are as many as 500,000 brownfield sites across the country.

Current or former industrial sites, or brownfields, can be polluted with a range of environmentally harmful substances, including heavy metals. A great need for inexpensive and efficient cleanup (remediation) technologies exists to restore these sites for productive use. There are two main biological methods of remediation: (1) *bioremediation*, which uses microbes to break down or immobilize toxic compounds, and (2) *phytoremediation*, which uses plants to accumulate contaminates and/or to break down waste into less harmful products (Irvine 1999). Although remediation technologies still are in their infancy, they offer much promise in dealing with environmentally toxic

situations. In addition to this obvious advantage, increasing vegetation in urban environments contributes positively to air quality and to open space availability.

Further research is needed to determine bioremediation efficiency and its effect on the food chain, air quality, and economic feasibility. The phytoremediation market in the United States was expected to expand from $16.5 million to $29.5 million in 1998 and from $55 million to $103 million in 2000, and is expected to expand from $214 million to $370 million by 2005 (Black 1999).

Remediation of brownfields and subsequent reuse can provide economic and environmental benefits to communities. Reusing brownfields discourages urban sprawl while retaining or creating new jobs for communities. Redeveloped properties serve as a tax-generating revenue, but the need of municipalities to generate short-term revenue has discouraged adoption of remediation processes. Research is needed to develop ways in which to accelerate the remediation process to ensure enhanced cost-effectiveness.

3 Agriculture's Service Role in Planning and Revitalization

Introduction

Community planning processes are the focal point for efforts to address some of the major challenges associated with urbanization: (1) managing growth; (2) landscape and energy modifications; (3) insect, disease, and wildlife management; (4) conserving and revitalizing land areas; and (5) merging the interests of stakeholders in the planning process. By bringing rural and urban interests together, planners stand to benefit from the integration of the diverse resources that each interest brings to the discussion. If the planning process is innovative and timely, mutually beneficial solutions may be reached. As urban populations expand, one of the greatest challenges is to recognize the value of the rural-urban partnership and the enormous future value associated with each of these components. Together, they create a synergy. The most common characteristics of sprawl include large-lot housing developments that overflow into the countryside; the separation of home from work, shopping, and schools; and residential dependence on automobiles for transportation.

Metropolitan farming is on the increase, with U.S. metropolitan farms constituting 33% of all farms and 16% of all cropland and contributing one-third of the value of all agricultural output. Although agriculture adapts to urban growth, it does so by changing the nature of its products and services. This change may result in more high-value products, more intensive production, or a switch to enterprises better suited to the urban environment and the proximity of customers. It is difficult to estimate the benefits of conserving rural land; studies suggest, however, that households may be willing to pay $1.4 billion to $26.6 billion annually to conserve rural lands. These amounts are equivalent to $13.5 billion to $255.8 billion in present value (Heimlich and Anderson 2001).

Growth and development are expensive consequences for receiving communities. Evidence suggests that the cost of unplanned, less dense development is higher than that of planned, denser development. For example, public services for residential development require $1.24 for every dollar generated by tax revenues, whereas farmland or open space costs only $0.38 for each tax dollar paid. Sometimes consumers, businesses, and communities fail to plan for future development because of lack of information or because it is difficult to imagine the long-term consequences. The accumulation of many small decisions can result in unanticipated outcomes. Although probably not a threat to national food and fiber production, urban growth may decrease the production of certain high-value crops (Heimlich and Anderson 2001).

There is a critical need to plan for agriculture as part of the land management process (Figure 3.1). Such planning would ensure agriculture's viability while simultaneously balancing the needs of the nonagricultural public, the natural environment, and the industrial sector. Incorporating agriculture into planning processes can benefit community and individual health and well-being. It also helps a community to take full advantage of potential agroecosystems services as well as other contributions derived from agriculture, as discussed in several of the following chapters.

Figure 3.1. Mahantango Creek watershed near Klingerstown, Pennsylvania. The combination of land use, soil properties, and hydrogeology largely determines vulnerability to surface and groundwater contamination by agricultural activities. Photo by Scott Bauer, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Maryland.

Managing Growth

Both metropolitan and rural areas are experiencing the effects of uncontrolled growth. This phenomenon, often referred to as *sprawl*, is found most often on the edges of cities and in rapidly expanding rural communities. Controlling sprawl can protect productive farmland and valuable ecosystem services. During the period from 1982 to 1992, 29% of U.S. agricultural land converted to urban uses was identified as *prime agricultural land*. The USDA's data from the 1980s indicated that 46% of land converted to urban and built-up use came from crop and pastureland, 38% from forest land, and 14% from rangeland (USDA 2001b). Between 1960 and 1990, the five-county area surrounding Cleveland, Ohio, lost 40% of its farmland. The seven counties of the Columbus, Ohio, metropolis lost the greatest amount of farmland in the state: more than 425,000 a., or more than 1,000 a./month, representing a 23% decrease. Although not all of Ohio farmland loss was due to sprawl, most development occurred on prime or unique soils (Chadbourne and Chadbourne 2000).

The opportunities for redirecting this growth must be seized quickly. If planning fails, the social, economic, and environmental costs will be enormous (Daniels 1999). Sprawling cities and suburbs consume productive farmland and forests, degrade watersheds, spawn automobile traffic, and create "bitter battle-grounds" (Daniels 1999). Sprawl leads to noise and air pollution and to the consumption of enormous amounts of fuel. In some people's minds, the loss of farmland and other natural areas is seen as a threat to quality of life (e.g., to clean water, wildlife habitat, scenic amenities), to local food access, and to agriculture's ability to contribute to the local economy. As land disappears, valuable agroecosystem services such as natural areas that filter water pollutants and storm water, prevent flooding, and recharge aquifers are being lost. In many situations, loss of farmland may lead to decreased economic contributions by agriculture to the community. Loss of farmland also limits opportunities for urban consumers to connect with the source of their food and to enjoy the benefits of fresh, high-quality, locally produced food.

Local, county, and state governments can do a more effective job of planning for agriculture and managing growth. States such as Maryland, New Jersey, Oregon, Rhode Island, Tennessee, and Washington have made important efforts to accommodate growth management and some of the needs of agriculture through policy initiatives. The trend has been to move away from state planning and zoning requirements to more decentralized models such as *smart growth strategies*, which provide incentives to influence the pattern and density of development. Smart growth principles that encourage appropriate land-use management include mixed-use development and conservation of open space, protection of rural amenities, mass transit and pedestrian-friendly community design, inner city investment, and environmentally friendly development.

Maryland, for example, has implemented a state farmland preservation program and a smart growth initiative through which the state partners with local governments, land trusts, and residents to protect farm and forest lands. Oregon has designated *urban growth boundaries* to separate rural and urban areas. Utah has a strategy that involves various stakeholder partnerships in the planning process. A number of monetary incentives have been used to protect farmlands, forests, and natural areas, e.g., preferential property tax assessment and purchase of development rights (PDRs)[8] and transfer of development rights (TDRs)[9]. Preferential property tax assessment has not proved very satisfactory as a long-term solution for slowing the loss of rural land, and PDRs have turned out to be especially expensive. In addition, they are not always attractive to farmers. Further discussion on farmland protection tools is presented in Chapter 7.

According to the proceedings of the 2001 conference on "Protecting Farmland at the Fringe," (Northeast Regional Center 2002), a blended approach for the preservation of farmland in the context of growth management is needed greatly. This approach should involve enhanced integration of policy goals, analytical modes, public policy tools, and jurisdictional boundaries. The goals and intentions of farmland and open-space protection often are either unclear or unacknowledged. Improved understanding of these

[8]Purchase of development rights (PDRs), a strategy for protecting farmland and/or community growth management, provides increased protection for farmland, forest, and natural areas. Purchases of development rights remove development potential from land areas by placing them in a protected status. This is a voluntary growth management strategy under which landowners are compensated for not allowing development of the property.

[9]Transfer of development rights (TDRs), a strategy for protecting farmland and/or community growth management, is used by local governments to shift farmland or other rural land resources to designated growth areas. The goal of a TDR is to enable a private developer to purchase TDRs and to use them in growth areas, or to restrict use for conservation. Some governments, however, have set up TDR banks to buy or sell TDRs to keep land preservation and development active.

goals is needed to allow for the design of policies to achieve goals congruent with real issues and stakeholder preferences. In practice, different policy approaches often are used together, to avoid conflicting applications. Finally, evaluation of blended policies must be monitored carefully to determine their effects. Consideration should be given to the design of regional approaches that cross political and other boundaries.

Environmentalists, consumer advocacy groups, and other social activists recognize the benefits of diverse farming systems as a mechanism by which to manage and to protect landscape, wildlife, and other natural resources. Although a diverse, organically managed farm may not provide the same crop yield as a nonorganic farm, its overall contribution in terms of environmental protection and services to the community may be greater. Evidence is increasing that agricultural and urban land-use practices can have a negative effect on the community and surrounding environment. Findings from a study by the U.S. Geological Survey's National Water Quality Assessment Program (2001) indicate that water quality conditions and aquatic health are influenced by land and chemical use, land-management practices, population density, watershed development, and natural features such as soils, geology, hydrology, and climate. The negative effects of farming practices on water and the environment have been well documented by previous CAST reports (1992a,b; 1996; 1999).

If planning was able to accommodate a better balance between diversified types of farming and other urban land uses, a number of valuable services could result. For example, if there was encouragement for the production and/or processing of local food for the surrounding community, transportation and marketing costs (which add to community infrastructure costs such as energy, roads, and packaging) could be decreased. Appropriate planning also could allow well-planned farms to provide service to growing communities on issues affecting the ecosystem, such as waste utilization, pollution remediation, habitat protection, and scenic amenities.

Landscape and Energy Modifications

Plants perform many architectural functions (Robinette 1972). These functions include definition and completion of spaces, control of privacy, screening of undesirable views, and framing of pleasant views. The most common use of plants for utilitarian purposes is for construction (i.e., built structures), as well as for screening undesirable sight lines and providing noise abatement. Plant spacing and canopy management and positioning can camouflage or mask undesirable visual features and conserve energy. Other engineering functions performed by plants include runoff and erosion control (Figure 3.2), glare reduction, filtering of particulate pollutants (e.g., dust), and CO_2 reduction. Plants can be considered a "living technology" that aid in maintaining a healthy environment (Coder 1996).

Properly positioned trees and shrubs can decrease summer air conditioning costs by as great as 40% (DOE 1993). Computer simulations indicate that 100 million properly placed trees in U.S. cities (three trees for every other single-family home) could decrease

Figure 3.2. In a wind tunnel, a technician prepares to measure how live plants and straw residue slow windblown soil erosion. Photo by Scott Bauer, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Maryland.

annual energy use by 30 billion kilowatt hours (kWh), leading to savings of approximately $2 million in energy costs (Huang et al. 1987). Further, simulations by McPherson and Rowntree (1993) indicate that a single properly placed 25-ft tall tree can decrease annual heating and cooling costs of a typical residence by 8 to 12%. Extrapolating nationwide, this practice would result in savings of approximately $1 billion. In addition to influencing energy use by shading, plantings also can affect heating and cooling by altering air movement around buildings. Furthermore, plants can contribute multiple benefits such as decreasing glare and influencing temperature by *transpirational cooling* (evaporation of moisture at the leaf surface). For example, a green bermudagrass turf canopy decreases glare and can have a maximum daily temperature that is 39°C cooler than a synthetic surface (Beard and Green 1994). Computer simulations for cities across the United States indicate that transpirational cooling decreases annual cooling energy demand by 2 to 8% (McPherson and Simpson 1995). The most significant savings are in the western United States, where low relative humidity improves transpirational cooling. For example, in Sacramento County, California, the urban forest is responsible for an annual air conditioning savings of approximately $18.5 million (Simpson 1998).

Indoor-Outdoor Air Quality

Filtering capacity of plants can improve both indoor and outdoor air quality; for example, a tree canopy can ameliorate parking lot temperatures. The canopy density has been included in models to predict motor vehicle emissions (Scott, Simpson, and McPherson 1999).

Studies on indoor air quality show that plants may contribute to reduction in "sick building" syndrome. The National Aeronautics and Space Administration funded early studies on the use of plants to clean the air in space stations. Common interior plants were highly effective in removing formaldehyde from sealed chambers (Wolverton, McDonald, and Watkins 1984). Further work documented similar effects with additional pollutants, including carbon monoxide (Wolverton, McDonald, and Mesick 1985), and began to document the mechanisms involved (Wolverton, Johnson, and Bounds 1989). One researcher looked at the ability of interior plants to affect indoor relative humidity (Figure 3.3) (Lohr 1992a,b). Plants in these studies did not contribute excessive humidity to interiors, which might damage building materials, but did raise relative humidity to levels within the range recommended for human health. Lohr and Pearson-Mims (1996) studied the influence of interior plants on dust, showing that adding plants to the periphery of a room decreased particulate matter deposition by as much as 20%. Other contributions include cleansing of air by slowing particulate materials (e.g., pollens, pollutants), absorption of carbon monoxide, and generation of oxygen. In one urban park (524 a.), tree cover was found to remove 48 pounds (lb) of particulates, 9 lb nitrogen dioxide, 6 lb sulphur dioxide, and 1 lb carbon monoxide daily (Coder 1996).

Insect, Disease, and Wildlife Management

Humans have altered environments through physical disruption or importation of new insect and ani-

Figure 3.3. Technicians at the base of a 3-story rainfall simulator study rainfall interception by foliage. Photo by Scott Bauer, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Maryland.

mal species. Thus the ecological balance has been disrupted, sometimes leading to the creation of habitats that either establish new insect or wildlife populations or stimulate existing population growth or decline. These alterations can have direct or indirect social and economic consequences. Maintaining human health and safety and protection of the landscape necessitates broad knowledge of the entire agroecological system.

Urban entomology, plant pathology, and wildlife management—three of the agricultural sciences—involve the management of insects, spiders, diseases, and animal populations (domestic and natural) living in association with humans and domesticated pets. Knowledge from this field becomes more important as the population shifts to urban centers. Insects, diseases, and animals associated with structures and with domestic and landscape environments can have a direct effect on the quality and safety of life. There are both tangible and intangible benefits, as well as real costs, associated with creating a balanced wildlife, disease, and insect management strategy, whether in an urban or rural situation.

The quantified economic benefits of wildlife in the urban environment are not readily available. In their continued pursuit of food, however, wild animals act as scavengers by cleaning up animal road kills and by eating copious amounts of insects. For example, although bats are among the most feared and least regarded mammals, they are one of the major predators of night-flying insects such as mosquitoes, gypsy moths, and Japanese beetles (BCI 2001). One bat can eat 600 to 1,000 mosquito-sized insects in one hour (hr). Besides eating insects, bats pollinate plants such as the saguaro cactus. Without bats to pollinate it, the desert ecosystem can be at risk (NCSU 2001a). One bat can easily eat 20 female corn earworm moths in a night, and each moth can lay as many as 500 eggs, potentially producing 10,000 crop-damaging caterpillars. As few as 8 caterpillars/100 plants can force a farmer to apply pesticides.

A cooperative effort between the U.S. Golf Association and Audubon International promotes ecologically sound land management, as well as the conservation of natural resources. The positive effect of this effort extends beyond the boundaries of the golf course and benefits the surrounding community. Audubon International (2001) provides each golf course with one-on-one assistance for development of an environmental plan. Golf courses must fulfill the following requirements: (1) a written environmental plan; (2) a wildlife and habitat management plan to provide habitat for wildlife; (3) public involvement to create awareness through education; (4) integrated pest management; (5) water conservation directed toward irrigation, recapture, reuse, variety selection, and maintenance; and (6) water quality management strategies.

The economic effects of urban wildlife and insects are explored most frequently in terms of the damage costs incurred by their presence. For example, according to a report by Curtis (2001), deer in suburban landscapes cause significant economic losses to residential landowners, present safety hazards, and are agents for transmission of Lyme disease. Curtis (2001) estimates that deer numbers in local parks and suburban landscapes may continue to double every two to three years, as long as forage is available, unless some form of control is implemented. If people choose not to take action, much greater expense will be incurred later. Based on homeowner surveys, wildlife damage has been estimated at $3.8 billion annually, with 4% of respondents reporting problems with deer (2.4 million households). These data indicate that deer damage alone may cost homeowners approximately $251 million/yr. A conservative estimate of the total number of deer-related vehicle accidents nationwide is 1.5 million annually, with vehicle repair (in 1993 dollars) averaging $1,577. The 726,000 accidents actually reported represent approximately $1.1 billion annually, less than half the estimated cost. The Centers for Disease Control and Prevention indicated that between 12,000 and 14,000 cases of Lyme disease have been reported annually in the United States since 1994 (Curtis 2001).

The creation of new environments changes the nature and existence of pests over time. For example, more diverse landscape plantings provide a greater diversity of pests. Urban gardening creates food for rabbits and insects and habitat for other pests. Development of recreational areas encourages new or different insects and other urban wildlife. Increased numbers of food-related establishments (e.g., warehouses, vendors, containers, processing plants, groceries, restaurants, cafeterias) in urban areas expand pest habitat. Building heating and cooling systems allows tropical and semitropical pests to flourish at northern and southern extreme latitudes (Keith 1997).

Waste and water management and artificial impoundment for water runoff create habitat for aquatic insects such as midges and mosquitoes. Problems with waste disposal include inadequate sewers, garbage facilities, and landfills, leading to selectivity of garbage collection. Lawn clippings no longer accepted by many cities can produce stable-fly problems

caused by improper composting. Examples of insects and animals creating health and economic problems in urban areas include houseflies, stable flies, horn flies, ants, mosquitoes, moths, fleas, ticks, cockroaches, termites, turf and ornamental pests, opossums, rats, mice, rabbits, deer, and raccoons. Also, wildlife feces can cause bacterial water pollution, especially when it rains.

Agricultural science is positioned to address the aforementioned issues. Areas of entomology, horticulture, plant pathology, veterinary medicine, animal and range sciences, and rural sociology can assist in the mitigation and management of undesirable insects, diseases, and wildlife that affect the health and well-being of natural habitats, humans, and domesticated animals. For example, agricultural scientists are developing vaccines for Lyme disease. Additional agricultural research is needed to address the growing insect, disease, and wildlife problems in urban areas. Research topics could include the following:

- isolation and identification of natural products (e.g., plant extracts, animal derivatives, and waste products) for pest control;
- chemical and behavioral ecology of insect, disease, and animal pests and their parasites for biological control programs;
- computer-aided decision making and problem solving in urban pest management;
- integrated pest management (IPM) programs for structural, ornamental, and nuisance pests;
- forecasting and management schemes for mosquito and other insect, disease, and animal populations;
- insect and animal growth and reproductive regulators and other reproductive control technologies;
- health and environmental impact analyses of pesticide application; and
- social, cultural, and economic impact analyses of pests that adversely affect animal and human populations.

Conserving and Revitalizing Land Areas

In the last twenty to thirty years there has been increasing public interest in the conservation of rural areas. Sometimes this interest has meant conservation of farmland for the production of food. In other instances, farmland has been seen as an amenity with scenic or recreational value, or has been viewed as having high economic development potential. The benefits of conserving rural land are often difficult to estimate because they differ depending upon the circumstances. Land conservation also has become a potentially divisive issue because of differing stakeholder values.

Disagreement over land and natural resource protection has made it especially important to create opportunities for broad stakeholder participation in planning processes. American Farmland Trust recommends a strategic approach that analyzes the land characteristics and the desired objectives and purposes. Some of the questions to be asked include: What are the ideal qualities of the farmland that is to be protected? How much of the land needs to be protected? What public interests will be served? Farmland protection is an expensive goal and one that few states and localities will be able to manage on their own; it is an endeavor in which other levels of government partnership are important (Thompson 1996).

Agricultural knowledge and practices can aid in land remediation and revitalization. As mentioned in the discussion of remediation, management of soils, soil microflora, and planting of specific types of plants can restore land to a more desirable state.

Vacant lands, neglected sites, and toxic dumps are crucial problems facing urban communities. If an area is dilapidated or vandalized, contains trash-filled vacant lots, or consists mainly of sterile steel and concrete, the message is sent that those in charge (the city government, the owner, or the employers) place little value on the area or the people living there. Under these circumstances it would seem that people have no intrinsic worth and no control over their environment, that this is not an appropriate place in which to reside or to invest. A study in Atlanta (Brogan and Douglas 1980) examined the association among psychosocial health of the community, physical environment (e.g., landscaping and nearby land use, and sociocultural environment (e.g., population density and income). Data indicated that both physical and sociocultural environments were equally important in explaining variations in the psychosocial health of the community.

In Baltimore, Maryland, a Community Greening Grants Revitalization Program provides small grants to create community-managed open space. Baltimore has an estimated 40,000 vacant lots covering 11% of the city's land area. About 12,000 lots owned by the city represent a burden to the city, in that they are no one's responsibility. As a result, they have become a social blight on the neighborhood instead of a bene-

fit to the community. Community Greening programs can address this issue by turning abandoned property into community-owned property through the adoption of vacant lands by local residents for use as community gardens, parks, or tree nurseries. Cost estimates for a city to clean up a problem lot range from $2,000 to $4,000 annually (Community Resources 1996). For an investment of as little as $200 to $1,000, open spaces can be rehabilitated effectively. Each year, this Community Greening program takes approximately 20 lots out of the solid-waste lot cleanup system, providing a potential saving of $40,000 annually to the city, and many benefits to local residents.

Community gardens are a fairly new and increasingly popular urban activity (Figure 3.4). Financial feasibility is only one of their challenges. Because such gardens are so new, city agencies often do not know how to handle them. For example, in Philadelphia, more than 15 agencies address land-disposition (Hope Wohl Associates 2000). Furthermore, certain public agencies have little experience with issues such as soil remediation or agricultural regulatory activities. Currently, the predominant sources of funding for community gardens are local governments, followed by the federal government, nonprofits, and universities (especially cooperative extension). State government, special fund-raising activities, neighborhood associations, and local banks form the second tier of support (Feenstra, McGrew, and Campbell 1999). These projects may generate relatively little income but contribute in other ways to the community.

In a study of community gardens and city-managed parks in Sacramento, California, researchers found that community gardens were 20 times cheaper to create and 27 times cheaper to maintain than city parks were. The Sacramento study compared the development and maintenance costs of a park containing 140,000 sq. ft. with the same costs in a community garden containing 121,300 sq. ft. The researchers found that the park cost $46,000 to develop and $15,000/yr to maintain whereas the garden cost $2,200 to develop and $550/yr to maintain (Francis 1987). Although there are regional cost differences based on climate, labor costs, and so on, the evidence suggests that community gardens are less expensive to build and to maintain than parks are.

Figure 3.4. A local resident works in a community garden in Chicago, Illinois. Photo by Ken Hammond, U.S. Department of Agriculture.

Agriculture in all of its variety can be an integral part of urban revitalization. Kaufman and Bailkey (2000) address the obstacles and possibilities for applying entrepreneurial agriculture to revitalize vacant or neglected urban land areas. After completing a study of 27 cities, they concluded that there were four major obstacles to the growth of urban agriculture as an economic development or land revitalization strategy.

- **Site-related obstacles**. Vacant urban sites often are contaminated from previous industrial use or post-demolition activities, and efficient, widespread cleanup often is scarce. Another site-related problem is lack of secure tenure or problems acquiring land for farming. Monroe-Santos (1998) found that of 6,018 recently surveyed gardens (entrepreneurial and nonentrepreneurial), only 1.5% were permanently secured in a land trust or other form of permanent ownership.
- **Government-related obstacles**. Property disposition by cities often involves an arduous process that impedes the transfer of land to organizations seeking to farm there. Additional obstacles are approval of agricultural land uses, licensing and health regulations, and lack of funding to assist agricultural enterprises involved in economic development activities. Perhaps the greatest obstacle is planners' widespread perception of gardens and urban farming as a temporary or conditional use—a way to use the land while waiting for "higher and better uses" that might yield higher property taxes.
- **Procedural obstacles**. Urban gardens and farms face inadequate capital and operating financing; difficulties in recruiting and keeping qualified and committed staff in a labor-intensive operation; and challenges associated with small economies of scale, inadequate business plans,

and ineffective public relations.

- **Perception-related obstacles**. Urban activities in food production are most challenged by perceptions among policymakers, urban opinion-shapers, and the general public that farming is a rural, not an urban, pursuit; that farming is not the best use of urban land; and that farming is an ineffective economic development strategy when compared with, for instance, a strategy that attracts large industry. These perceptions are coming under attack from a number of directions. Communities slowly are recognizing the potential of urban agriculture for comprehensive community betterment, and not only from an economic development or a land-use strategy standpoint (Kaufman and Bailkey 2000).

Agroecosystem services can assist planners with issues associated with growth. Because agriculture has not been viewed typically as a service to the environment (farms have been viewed as producers of food), many of today's farms would find this role a challenging opportunity. Designing farms to fulfill ecological service needs would require agencies, public decision makers, and farmers to rethink farming systems and incentives for change. This may be an opportunity for institutions of higher education and the media to educate the public about expanding agriculture's service roles. Such a change in thinking would require additional research, as noted previously, and close working relationships among agricultural resource people (farmer/ranchers, scientists, and extension personnel) and urban leaders, planners, and citizens' groups.

Merging the Interests of Stakeholders in the Planning Process

Stauber (2001, 11) claimed that one's relationship to nature is a key determinant of what is rural, and that "rural requires a symbiotic relationship with place." There is every indication, however, that urban people also crave a relationship with nature and all those elements that are associated with what may have once been an agriculture heritage—animals, green spaces or parks, forests or wilderness areas, fresh locally produced food, relationships with local farmers, and so on.

Comprehensive planning processes can document economic and other benefits of local agriculture and identify important support activities, e.g., products for marketing, housing for farm workers, waste disposal, and roads. Local and regional planning, coordination, and negotiation of commonly valued resources across regions and levels of government are equally important. As noted by Pezzini and Wojan (2001), there is a need for shared commitment and dialogue regarding the preservation and use of appreciated resources. This suggests it is important to develop zoning ordinances and other incentive programs to protect rural, urban, and urban-edge agriculture and natural areas from development that could otherwise destroy them.

Sokolow (2000) outlines a number of policy strategies, many of which are implicit in smart growth trends, which communities can use to divert growth away from productive farmland and fertile agricultural soils. The challenges, however, are to minimize potentially negative interactions between state- and local-level administrators and to create conditions for a long-term and mutually beneficial coexistence between farmers and nonfarmers. If agricultural interests are included in this planning process, they can play a useful role in these and other rural-urban planning activities. Communities that are experiencing an influx of new residents must balance the demands of agricultural interests with the often-different interests of nonfarming residents. The leaders of these urbanizing communities must facilitate meaningful dialogues and participatory planning processes that involve both newcomers and oldtimers.

4 Agriculture's Business Contributions to the Urbanizing Society

Introduction

This chapter discusses certain major business and economic contributions of agriculture in urban areas. Although the agroecosystem provides society with a number of direct and indirect services that are difficult to quantify (as discussed in Chapter 2), agriculture has other important benefits. Some are more direct, as in the case of production and marketing of products and services. Many of these benefits are well documented through statistical or other economic reporting agencies.

The particular agricultural business benefits selected for attention in this chapter include (1) environmental horticulture and the green industry; (2) the companion animal industry; (3) the equine industry; and (4) aquaculture.

Environmental Horticulture and the Green Industry

Environmental horticulture, sometimes referred to as *ornamental horticulture*, is defined broadly as the cultivation of indoor and outdoor landscape plants for use in populated environments (Pittenger, Gibeault, and Cockerham 1991; Templeton et al. 2000). Enterprises that engage in the commerce of environmental horticulture (e.g., nurseries, greenhouses, sod farms, landscape maintenance firms) are referred to collectively as the *green industry*. This industry has expanded considerably in recent years and is larger than most people realize. Further, it generally is centered in and around MAs. In 1993, the total economic activity generated by the U.S. green industry was more than $44 billion, and the industry provided nearly 440,000 jobs (ANLA 2001). In 1999, the total value of retail sales for green industry products climbed to around $57 billion (USDA-ERS 1999), and employment was around 600,000 during peak seasons (ANLA 2001).

Most people equate agriculture with farming and do not typically think of green industry activities as farming. Nonetheless, agricultural colleges in LGUs across the nation provide the primary research and educational base for the green industry. Furthermore, in terms of total economic output, the green industry ranks as the second most important sector in U.S. agriculture, behind only the beef industry (USDA-ERS 2000a). According to grower receipts, the green industry ranks sixth in U.S. agricultural commodities (behind cattle, dairy products, corn, hogs, and soybean). The green industry sector ranks in the top five agricultural commodities in 27 states, most of which are urbanized. The leading states in terms of grower receipts are California and Florida, two of the most populated states in the nation.

When viewed as farms, green industry production units have an average net farm income approximately four times greater than the U.S. average net farm income (Johnson and Christensen 1995). Accordingly, the green industry often is described as producing high-value crops. In 1990, the green industry ranked as the second leading employer in U.S. production agriculture (Turner and Kriesel 1995). The green industry is considered the fastest growing agricultural sector (USDA-ERS 2000a) and clearly is an important economic component in U.S. agriculture.

Environmental horticulture and the green indus-

Figure 4.1. A homeowner and his daughter weed a flower garden in front of their home in Placerville, California. Photo by Ken Hammond, U.S. Department of Agriculture.

try affect a large segment of the U.S. population, especially homeowners who spend considerable time and/or money maintaining their landscapes (Figure 4.1). But even apartment dwellers value (and indirectly pay for) green spaces in or near their complexes. As income and population increase, demand for recreational activities dependent on the products of environmental horticulture (e.g., athletic fields, botanical gardens, parks, golf courses) also increases (Templeton et al. 2000). Without a doubt, environmental horticulture and the green industry have tremendous potential for improving communities.

Table 4.1. Nursery and greenhouse crop production data for the top five states in terms of total sales for the year 1997. Data from 1992 also included for comparative purposes (USDA 1999)

	1997		1992	
State	Sales ($ million)	Number of farms	Sales ($ million)	Number of farms
California	2,222	4,988	1,662	3,824
Florida	1,450	5,121	1,024	5,180
Oregon	676	4,195	364	2,309
Pennsylvania	640	3,877	532	2,260

Nursery and Greenhouse Crop Production

The United States leads the world in the production of nursery and greenhouse crops (USDA-ERS 1997b; 2000a). Much of this production is located near urban population centers. For example, the list of top floricultural growers in the United States reveals that all are headquartered in or near urban areas and that most of their production facilities are located near urban areas (Appendix A, Table A.13). This collocation is due primarily to the fact that most large growers began their operations by serving regional supermarkets, discount centers, and home improvement chains (Onofrey 2000). The top states for nursery and greenhouse production are listed in Table 4.1. With the exception of Oregon, the states are highly urbanized. With regard to Oregon, much of the state's nursery and greenhouse production is located in the Willamette Valley between Portland and Eugene.

Total grower receipts for green industry crops have risen steadily during the past decade, and in 1998 were approximately $12 billion (USDA-ERS 1999). The major components of this production are summarized in Table 4.2. In terms of both the total number of farms and total sales, nursery crops (e.g., trees, shrubs, groundcovers, vines) and bedding plants (e.g., plants grown for use in flower beds, often referred to as *color* within the industry) are the two largest components of green-industry crop production. Potted flowering plants (e.g., chrysanthemums, poinsettias [Figure 4.2]), foliage plants (e.g., house plants), and cut flowers also are major components of the industry and often produced in protected spaces (e.g., plastic or glass greenhouses).

Figure 4.2. Poinsettia is the number-one flowering potted plant in the United States, even though its traditional sales period is just six weeks. Photo by Scott Bauer, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Maryland.

Table 4.2. Production area and wholesale sales data for major components of the U.S. nursery and greenhouse crop production in 1997 (USDA 1999)

Component	Protected production area (square ft)	Field production area (acres)	Total number of farms	Total sales[a] ($ million)
Bedding plants	307,696,181	20,085	18, 393	2,392
Bulbs	3,749,931	8,837	1,104	74
Cut flowers and greens	149,650,921	36,394	5,381	718
Flower and vegetable seed	3,004,025	74,526	1,785	124
Nursery crops	135,803,501	349,420	18,860	3,382
Potted flowering plants	155,298,507	4,385	7,390	1,068
Potted foliage plants	159,262,590	9,677	4,349	703

[a]Total dollar sales expressed in the table correspond to the figures represented in the table.

Although the United States is the largest producer in the world, it is a net importer of nursery and greenhouse crops (USDA-ERS 1997b, 1999, 2000a). In 1998, total value of imported nursery and greenhouse crops was approximately $1.1 billion compared with an export value of $264 million. The majority of import value (about $650 million) is attributed to cut flowers (e.g., roses, carnations), which are produced in large quantities in countries such as Colombia, Costa Rica, and The Netherlands. Nursery and greenhouse crop exports go primarily to Canada and Europe.

Figure 4.3. Greenhouse production of bedding plants. Photo courtesy of Tim Davis, Texas Agricultural Experiment Station, Dallas.

Retail Garden Centers and Nurseries

In 1998, retail sales for nursery and greenhouse products were nearly $55 billion (USDA-ERS 1999). Per capita expenditures for indoor (e.g., cut flowers, potted plants) and outdoor products (e.g., bedding plants [Figure 4.3], nursery stock) were approximately $60 and $141, respectively. Compared with other countries, the United States ranks twelfth in the world for per capita expenditures for indoor flowers and plants. In contrast, U.S. consumers spend two- to threefold more per capita on outdoor plants than consumers in other developed countries do. According to Butterfield (1998) almost three-quarters of U.S. households participated in some sort of lawn and garden activities. The average amount spent per household was about $385 in 1997 (Butterfield 1998).

Not surprisingly, a major portion of green industry products are sold where people live, that is, in urban/suburban areas. The leading states in retail lawn and garden sales all have large urban populations (Table 4.3). In terms of total sales, home improvement centers (e.g., Home Depot, Lowe's) are the largest lawn and garden retailers (Figure 4.4) (Morey, Morey, and Morey 2000). Other major retail outlets for green industry products are discount department stores (e.g., K-Mart, Wal-Mart); garden centers, which tend to be owned and operated regionally (e.g., Armstrong Garden Centers in California, Calloway's Nurseries in Texas); and supermarkets (e.g., Albertson's). The top lawn and garden retail businesses in the United States (in terms of total sales) are shown in Appendix A, Table A.14. All these retailers have major urban/suburban presences.

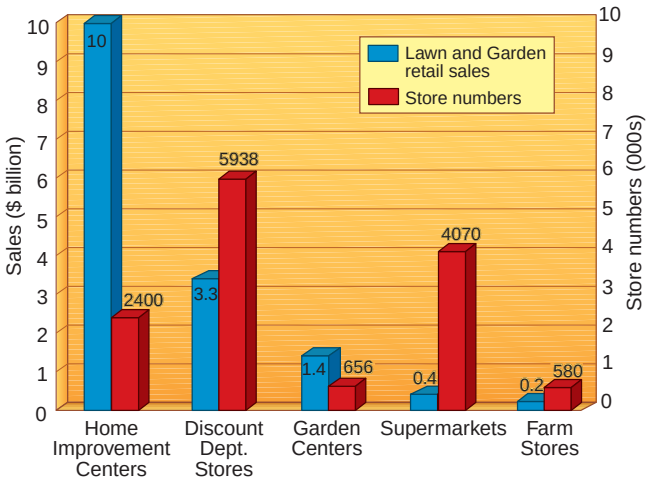

Figure 4.4. Lawn and garden retail sales and store numbers for various types of retail outlets represented in the top 100 U.S. retailers.

Landscape Design, Installation, and Maintenance

The landscape portion of the green industry is divided into three segments: design, installation/construction, and maintenance. Design of outdoor spaces in urban areas is done by licensed landscape architects (for relatively large, complex projects),

Table 4.3. Top ten states in terms of lawn and garden retail sales in 1997 (*Nursery Retailer* 1998)

State	Sales ($ billion)	% of total U.S. sales
California	7.9	10.3
New York	6.1	8.0
Texas	4.6	6.1
Pennsylvania	4.1	5.3
Illinois	3.9	5.1
Ohio	3.7	4.9
Michigan	3.2	4.2
Florida	3.1	4.0
New Jersey	2.5	3.3
Massachussets	2.0	2.6

landscape designers, landscape contractors, nursery employees, or do-it-yourself homeowners. In 1999, approximately $2 billion was spent for landscape design in the United States (ANLA 2001). Installation and construction of landscapes generally are accomplished by landscape contractors or homeowners. Total expenditure for landscape installation and construction in the United States was approximately $6.1 billion in 1999 (ANLA 2001). Maintenance of landscapes is accomplished by a variety of groups such as landscape contractors, specialized maintenance firms, public agencies, and homeowners. The total amount spent on maintaining U.S. landscapes is difficult to determine because of the wide variety of businesses and types of landscapes maintained. Nonetheless, total annual expenditures for residential tree care in the United States in the mid-1990s was estimated at approximately $1.5 billion (*American Nurseryman* 1997). Similarly, residential shrub and lawn care expenditures were approximately $1.4 billion and $6.4 billion, respectively, in 1997 (Butterfield 1998).

A large urban state, California maintains 1.4 million a. of landscape area, about half of which is residential landscapes. Average annual expenditure intensity (dollars spent/unit land area) for California landscapes was about $5260/a. (Templeton et al. 2000).

There are other indirect economic benefits of the green industry. These benefits include worker employment (estimated at 600,000 during peak seasons) and expenditures for "hard goods," which include fertilizers, pesticides, soil amendments, irrigation systems, lawn mowers, and other gardening equipment used to produce and to maintain plants. Landscapes also influence real estate values. It is estimated that landscaping adds 7 to 15% value to a U.S. home (ANLA 2001). Plants also can serve as a tourist attraction (see Chapter 6).

Turfgrass Production and Management

The turfgrass industry includes two major components: production and management. Turf is produced most commonly by means of either seed or sod. Grass seed production in the United States is centered in the Pacific Northwest, with Oregon being the leading state nationwide (grass seed production in 1998 valued at $338 million) (ODA 2001). Sod is produced on specialized sod farms typically located near urban areas. Sod is highly perishable and cannot be economically stored or transported extremely long distances. Nationwide, there are 1,800 sod farms that collectively have more than 300,000 a. of production (USDA-NASS 1997a). Total grower receipts for sod sales in 1997 were slightly more than $800 million.

Turfgrass management is a large enterprise in the United States. The total amount spent on turfgrass maintenance is difficult to determine accurately because of the variety of turf areas (ranging from home landscapes to golf courses to athletic fields) and groups that maintain them. Total do-it-yourself expenditures for residential lawn care in 1997 were estimated at $6.4 billion at the retail level, with an average household expenditure of $146 (Butterfield 1998). Approximately 45% of all U.S. households (46 million households) were involved in do-it-yourself lawn care. Texas, one of the larger turf maintenance states, maintains approximately 3.5 million a. of turf (Lard and Hall 1996), with total maintenance expenditures of $4.13 billion, averaging $1,200/a. More than 60% of total expenditures were for single-family residences.

Foliage Plants and Interiorscapes

Production of foliage plants is centered in large urban states. Indoor plant use increased dramatically during the environmental movement of the 1960s and 1970s. Accordingly, a specialized segment known as the *foliage plant industry* emerged within the green industry. More recently, the importance of having plants in or near working, living, and recuperative environments has been documented more clearly by scientific research (Fjeld 2000; Lohr and Pearson-Mims 2000; Lohr, Pearson-Mims, and Goodwin 1996; Shoemaker et al. 1992; Ulrich 1979, 1981, 1984; Ulrich and Parsons 1992). Thus, plants have come to be used widely in building environments such as shopping malls, office buildings, and hotel lobbies. A recent survey indicated that about half of corporate facility managers used interior plants in 75 to 100% of their buildings (Landicho 2000). Additional details regarding plant/human interactions can be found in Chapter 5.

Production of foliage plants for interiorscapes is more than a $700 million/yr business (USDA-NASS 1997a). The top three foliage-producing states are Florida ($400 million/yr in grower receipts), California ($135 million in grower receipts), and Texas ($30 million in grower receipts).

Approximately 30% of U.S. households use foliage plants indoors (Butterfield 1998). Retail sales of foliage plants in 1997 were approximately $1.1 billion, and average household expenditure was approximately $40/yr. Design, installation, and maintenance of interiorscapes in commercial buildings usually is carried out by specialized interior contractors, some of whom also service the outdoor landscape market

(West and Ott 1997). Services provided include plant rotations, pesticide applications, fertilization, pruning, and holiday decorating. Little information is available with which to quantify the economic contributions of the aforementioned activities.

Cut Flowers

The floral industry in the United States is large and somewhat more complex than other segments of the green industry. Cut flowers (e.g., roses, carnations) are produced by growers, many of which are located outside of the United States. Growers sell floral products to wholesalers, which, in turn, sell to retail outlets such as florist shops and supermarkets. Because many floral products can be shipped long distance by air freight, retail sales are not necessarily proximal to production. Nonetheless, most cut flower production, whether or not in the United States, is located near urban areas because of the need for airports to facilitate shipping. Not surprisingly, wholesalers and retailers of floral products are located primarily in urban areas.

In 1997, cut flower production occurred on approximately 5,300 farms and generated $717 million in grower receipts (USDA-NASS 1997a). The three leading states in cut flower production were California ($368 million in grower receipts), Florida ($175 million), and Hawaii ($30 million). The domestic production of major cut flowers such as roses and carnations has been decreasing in recent years due to strong foreign competition. In contrast, domestic production of specialty cut flowers such as snapdragons, sunflowers, baby's breath, and statice has been increasing. A specialized segment of the floral industry is the production of cut green material that is used typically as filler in floral arrangements.

The import value of cut flowers in the United States has risen substantially during the 1990s, and more than 3 billion stems now are imported annually (USDA-ERS 1997b). Approximately 75% of foreign-produced cut flowers (approximately 11 million boxes/yr) are processed through Miami International Airport (MIA). Cut flowers are the largest single cargo product handled at MIA. This influx has created a specialized cut flower processing industry in Miami that employs approximately 5,400 individuals (USDA-APHIS 1996). Most flowers arrive at MIA from Central and South America and are inspected, processed, and then distributed primarily by truck. John F. Kennedy International Airport in New York also receives large numbers of cut flowers, most coming from The Netherlands. About half are sold in New York City, and the remainder distributed in the northeastern United States.

United States consumers spent approximately $8.2 billion (or about $31/capita) on floral products in 1996 (USDA-ERS 1997b). Carnations (1.4 billion stems or 5.3 stems/capita, 90% of which are imported), roses (1.2 billion stems or 4.4 stems/capita, 71% of which are imported), and chrysanthemums (746 million stems or 2.8 stems/capita, 89% of which are imported) are sold in the largest quantities (USDA-ERS 2000a). Overall, less than half the cut flowers purchased by consumers are produced domestically. Nationwide, slightly more than half of all floral products are sold by 42,000 retail florists. The remainder of the floral products are sold by 24,000 nonflorist businesses such as supermarkets, discount stores, and street vendors (Figure 4.5).

Another specialized spin-off of the floral industry is wire service delivery (e.g., Telflora, 1-800- Flowers, Florafax International). Approximately $1.2 billion/yr in cut flower sales are processed through these services (Flora-Stats 1998). This business is accomplished by 29 million deliveries, most in urban areas, with an average value per delivery of $41. Floral prod-

Figure 4.5. Street vendor selling cut flowers.

uct wholesalers, which link producers with retailers, are located primarily in urban areas. The typical wholesale firm has annual sales of $3.7 million, a pretax profit of 2%, and a pretax return on assets (profit before taxes as expressed as a percentage of total assets) of 7.6%.

Companion Animal Industry

Companion animals (e.g., horses, dogs, cats, ferrets, alpaca, snakes, birds) play a large role in the urban economy. The companion animal industry includes the retail sales of animals, food, toys, health care, and other supplies for pets, and the jobs created to groom, kennel, and care for animals. Businesses supporting pet owners include veterinary clinics and hospitals, animal breeders, retail outlets, petting zoos, insurance agencies, cemetery and cremation providers, and pet farms. Examples of the economic impact of the companion animal industry are the following: (1) in 1999, the pet-food industry reported sales of $25 billion/yr; (2) in 1998, U.S. households had 56.8 million dogs and 71.3 million cats; (3) U.S. residents spend more annually on cat food than on baby food; and (4) U.S. grandparents annually spend an average of $195.24 on their companion animals, compared with $178.68 on their grandchildren (Bachman 2002).

Companion animals are projected to be a significant new market for human pharmaceuticals as crossover products, especially in the areas of anti-inflammatory drugs, cardiovascular and gastrointestinal treatments, behavior-modifying agents, and cancer drugs. According to the Theta Reports (2001), markets for veterinary pharmaceuticals, diagnostics, and animal products are expanding rapidly. The veterinary immunodiagnostics sector is projected to grow 50% by 2005, an increase of $189 million from the 1999 value.

Equine Industry

According to a 1996 study commissioned by the American Horse Council Foundation, the U.S. horse industry is a $25.3 billion business. This diverse industry combines primarily rural activities (e.g., breeding, training, maintaining, riding, and working on farms and ranches) with more urban activities (e.g., racetracks, betting parlors, horse shows, public stables, police work). The study concluded that there were more than 6.9 million horses in the United States, including commercial and recreational horses. The estimated number of people employed directly by the industry is more than 619,400 and 338,500 of these people are in full-time jobs. The industry is said to generate 1.4 million full time equivalent (FTE) jobs throughout the United States and involves 7.1 million U.S. residents as owners, service providers, employees, and volunteers. The industry pays $1.9 million in taxes to federal, state, and local governments annually. In urban areas, it has a direct economic effect of $2.8 billion, and in rural areas it has a direct economic effect of $22.5 billion (AHCF 1996)

Increased animal populations are common to urban-fringe areas or in the rural-urban confluence. Many kinds of livestock, including horses, are associated with small acreage ranchettes or hobby farms (Figure 4.6), which frequently are interspersed with farm businesses. Case studies of three rural-urban watersheds in the Lower Fraser River Valley (British Columbia) highlighted some of the potential problems associated with this livestock build up. One case reported on the Salmon River watershed, which is on the rural-urban fringe of the Lower Mainland, west of the city of Abbotsford. This once predominantly agricultural area is the home of an expanding residential community interspersed with intensive farm operations. More and more people have moved to this area in search of a pastoral place to live, the result of which is a growing number of hobby farms. With this human migration to rural areas, the reported number of horses has increased by 100%. Excessive nitrate loading from animal wastes and fertilizer application is affecting water quality in this ecosystem. As numbers of people and animals increase, so does the potential for nitrate-N leaching into the aquifer (Berka, McCallam, and Wernick 1995).

Without careful management, a large horse-population can have negative environmental effects. For example, erosion from poor pasture or trail manage-

Figure 4.6. Horses graze next to housing in Montgomery County, Maryland. Photo by Tim McCabe, U.S. Department of Agriculture.

ment can contaminate waterways; flies and dust can be a health hazard; and excessive fertilizer and chemical use on forage production can lead to contaminated water supplies. Tourists attracted to horse-related enterprises can litter, vandalize, and destroy natural areas. On the other hand, horses can make positive contributions to recreation, tourism, business development, and individual therapy.

Aquaculture

Aquaculture is the rearing of aquatic plants and animals under controlled or semicontrolled conditions (Stickney 1994). Practiced for more than 2,000 years in Asia, aquaculture is one of the fastest growing food-producing industries in the world today (NFI 1993). Although aquaculture has been practiced for more than a century in the United States, most industry growth has occurred over the past two decades. The U.S. aquaculture industry is ranked ninth in the world in terms of the value of its products (nearly $6.86 million) (New 1997); it also accounts for nearly 181,000 jobs (USDA-ERS 1995). Global seafood demand is expected to grow by 70% in the next 35 yr as the global population increases. At the same time, worldwide wild catches of many fish species are declining or have leveled off at maximum sustainable yields. For example, near collapse in the stocks of cod, halibut, and a number of other species has caused the U.S. and Canadian governments to impose severe harvesting cutbacks in the Georges Bank fishing area of the northern Atlantic. As a result, the United States and Canada have placed increased priority on cultivating these species (USDA-ERS 1995).

To meet worldwide seafood demand, it is projected that aquaculture production will have to increase sevenfold, from 11 million to 77 million metric tons (Mt) by the year 2025 (USDA-ERS 1994).

Figure 4.7. Workers harvest catfish from the Delta Pride Catfish farm in Mississippi. Photo by Ken Hammond, U.S. Department of Agriculture.

Urban and periurban aquaculture faces major challenges in sustainability. This is associated with three major trends:

1. Movement toward intensification and use of industrial technology, high production costs (e.g., water, feed, drugs), environmental effects, and the targeting of high-income customers;
2. Intensity of urban development in pre- or rapidly industrializing cities that limits resources and the use of traditional practices, and late-industrializing cities that favor environmental policies to encourage healthy production systems; and
3. Urban-rural interfaces leading to more intensive practices, higher production costs, and fewer opportunities for low-income producers, all of which make the sustainability of these practices a delicate issue given the potential for pollution in an already vulnerable urban environment (Martinez-Espinoza 2000).

Future aquaculture opportunities are associated with cultivation of fish for food in a controlled environment, such as a tank or pond, and harvesting them at a given size. For instance, FreshMarket Aquafarm in Holyoke, Massachusetts, cultivates Tilapia, an easy-to-breed and inexpensive-to-feed species relatively free from parasites and disease. This type of aquaculture may represent a more environmentally and socially acceptable alternative to other types. In an ethnically diverse community such as Holyoke, the operator of FreshMarket Aquafarm has found an advantage in being able to target new types of customers and to contribute to the economic development of the community (Ferguson 2001).

The aquaculture industry in the United States is dominated by freshwater catfish production (Figure 4.7), which generates more than $1 billion annually. Growth in other species, such as hard clams and Atlantic salmon, has been continual, however. Although the industry provides a number of economic benefits, it can cause the following environmental problems: biological pollution (from fish that escape from aquaculture farms into wild fish populations), fish for fishfeeds (wild-caught fish as feed, which depletes the natural population), organic pollution and *eutrophication* (nutrient loading through fish waste discharge), *chemical pollution* (potential harm from antibiotic and pesticide use), and *habitat modification* (marine predators may be unintentionally harmed) (Goldburg, Elliott, and Naylor 2001).

5 Agriculture's Contributions to Community Health and Well-Being

Introduction

Residents of the United States are increasingly adopting a fast-paced life style. More amounts of personal time are being devoted to commuting and business activities, and less time to personal life. Daily exposure to a harsh and often unnatural environment heightens awareness of the need for aesthetically pleasing indoor and outdoor environments. Daily contacts with nature that take place within landscapes around homes, on the way to work, and in the workplace, make important contributions to a healthy personal, family, and work environment. Although an arbitrary choice has been made about whether to address these issues as "individual" or "community" health contributors, in several instances the issues could easily be handled in either category, such as the benefits that landscapes and natural settings provide for daily freeway commuters.

For the purposes of this report, *community health* refers to the social and economic capacity of a community to create an environment that sustains the visions, goals, and needs of the residents. This is achieved primarily through residents' interactions with each other, with people and organizations outside the community, and with the physical surroundings. Both rural and urban communities consist of human, natural, and built environments. The health of this rural-urban agroecosystem is dependent on the quality of plant, animal, and built community relationships.

The purpose of this chapter is to draw attention to the role that plants and animals play in everyday human and community health. The following topics are discussed: (1) individual health and well-being; (2) community quality of life; and (3) community food systems.

Individual Health and Well-Being

Agricultural activities in such endeavors as forestry, horticulture, veterinary medicine, animal science, agroecology, sociology, and community development are positioned to contribute to the development and the maintenance of more user-friendly urban environments. Such environments are conducive to relaxation, productivity, learning, and psychological health. Human–animal relationships are another part of the personal health equation. Careful attention should be paid to the role and the effects of animals in the urban setting, both as companions and as part of the natural landscape. Companion animals traditionally have not been viewed as an agricultural component; for centuries, however, humans and livestock have been closely connected. Horses are a primary example, as are other forms of livestock (cattle, sheep, pigs, and goats) that have been included in 4-H and state fair programs, all of which are well accepted in the agricultural community. The authors contend that the science of human–companion animal relationships will increase in importance as society becomes more urbanized. Although human and animal relationships have been shown to decrease stress and to serve as therapeutic mechanisms for improved personal health, there also are undesirable health (personal, social) and environmentally related effects that accompany their presence in areas of high population density.

Companion animals offer therapeutic and health benefits for people of all ages. For example, pet owners have been found to have lower blood pressure and lower triglyceride and cholesterol levels (Anderson, Reid, and Jennings 1992). Pet owners have fewer minor health problems and better psychological well-being and physical health (Serpel 1990). They also have a higher survival rate after experiencing coronary heart disease (Friedmann and Thomas 1995). Dogs are preventive and therapeutic measures against everyday stress (Allen et al. 1991; Baun, Oetting, and Bergstrom 1991; Nagengast et al. 1997; Raina et al. 1999). Pets positively affect autistic behavior in children (Redefer and Goodman 1989). The elderly who own dogs go to the doctor less frequently than those who do not own dogs. Siegel (1990) found that Medicare patients who own pets had 21% fewer physician contacts than nonpet owners did.

Although it is difficult to carry out scientific studies about the effects of pets, animals, and plants on

residents of treatment and/or care institutions, Thomas (1994) attempted to create a relatively humane environment for nursing home residents. He envisioned homelike surroundings with companion animals, flower and vegetable gardens, visiting children, and on-site day care for younger children. Committed to the eradication of loneliness, helplessness, and boredom, Thomas created the Eden Alternative, in which birds, dogs, and cats interacted daily with residents. Planned landscapes, rabbits, and chickens also contributed to the atmosphere. Dramatic reductions among the Eden group in the use of psychotropic drugs for mind and mood altering, fewer deaths than in the control group, and improved mental outlook among residents were well documented.

The understanding of human–animal and human–plant interactions is crucial to the serving of populations with special therapeutic needs (e.g., individuals suffering from physical abuse, autism, depression, sensory impairments, substance abuse, and social deviation). Plants and planted landscapes (indoor and outdoor) are effective healing tools in ameliorating mental and physical disabilities. Landscape architects actively explore both healing landscapes and therapeutic garden design for horticultural therapy (HT). The uniqueness of landscape design for nursing homes and other housing facilities for elderly and disabled persons is recognized internationally. Ulrich's (1984) classic research reported that hospital rooms with views of trees rather than brick walls shortened patient stays in hospitals, encouraged decreased dosages of pain relievers, and lessened the amount of patients' negative feedback to the medical staff. Cimprich (1993) reported that participating in restorative nature activities helped women recover from breast cancer.

The profession of HT is one of several processes used to treat psychological and physical disorders. Horticultural therapy programs are found in psychiatric hospitals, physical rehabilitation facilities, educational centers for individuals with intellectual impairments, and similar treatment facilities (Figure 5.1). Professional horticultural therapists also work in vocational training programs, sheltered workshops, and prisons. In addition, arboreta and botanic gardens employ Registered Horticultural Therapists to conduct educational outreach programs for professionals and clients in treatment facilities in their communities (AHTA 2001).

Individuals engaged in horticultural activities benefit not only from associated physical exercise but also from the sense of pride and accomplishment associated with horticultural success (Hill and Relf 1982; Matsuo 1995). Nurturing plants can provide a sense of responsibility and belonging that often is lacking in institutional dementia care programs. McGuire (1997) found that contact with living plants can stimulate wonder and appreciation within the institutional environment while contributing a new sense of excitement. Therapeutic horticultural activities often are related to anticipation of the future as the gardener waits for the flower and the ripening fruit (Lewis 1988; Relf 1978). The potential of HT lies largely in its capacity to meet the needs and abilities of older adults and to rehabilitate and facilitate new skill development (Sarno and Chambers 1997). Horticultural therapy has been applied with positive outcomes in institutional dementia care programs developed, implemented, and modified to suit participant needs, abilities, and interests; HT also has been found to promote higher activity level, to improve mood, and

Figure 5.1. Raised-bed gardens make gardening accessible to all ages and ability levels. Photo courtesy of the American Horticultural Therapy Association, Denver, Colorado.

to maintain cognitive and functional skills (Bowie and Mountain 1997; Buettner 1995; Palleschi et al. 1996; Seifert 1998). Additional benefits include sensory stimulation and reminiscence (Namazi and Haynes 1994).

Commuting has become one of life's most stressful experiences. Through landscape applications, agriculture can help alleviate this type of stress. Increased blood pressure is associated with longer or more difficult commutes as are lowered job satisfaction, higher illness rates, absenteeism, and diminished performance on various cognitive tasks. Although the stresses of driving and commuting are documented, surprisingly few studies have looked at mitigating factors in the driving environment that might ease stress. A Texas A&M University team of social scientists (Parsons et al. 1998) studied the effects of roadside character on stress response. Using physiological stress indicators such as heart rate, blood pressure, and skin conductance, investigators discovered several response patterns. Drivers viewing built-up, strip-mall style roadside environments both slowed down and experienced impeded recovery from stressful situations. Study participants exposed to roadside nature scenes (forests or golf courses) returned to normal baseline measures faster and had a greater ability to cope with stress factors than those who were not so exposed. Researchers hypothesized an "immunization effect" in which exposure to a natural roadside setting diminished the magnitude of response to a later stressful task. This suggested that an "inoculation" of nature experience may enhance a driver's ability to cope with driving stresses.

Documented physiological changes related to recovery from stress include lowered blood pressure and decreased muscular tension (Ulrich and Simons 1986). Even brief, visual contacts with plants, such as in urban tree plantings or office parks, may be valuable in recovery from mild, daily stress. Ulrich and Simons (1986) have demonstrated that recovery from stress is facilitated when nature scenes are viewed. Honeyman (1987) suggested that even in an urban environment with buildings, settings with vegetation may be more restorative than settings without those natural elements.

The sedentary life style in the United States, as well as the preference for processed, easy-to-access foods and the abundance of food consumed, is an underlying factor associated with many major health problems, from heart disease, stroke, and diabetes to obesity and depression. Active participation in gardening has been found to be good exercise and, thus, good for physical health. Taylor (1990) reported that a person can burn as many calories in 45 minutes of gardening as in 30 minutes of aerobics. One hour of weeding burns 300 calories, the same as walking or bicycling at a moderate pace, and push-mowing of a lawn burns 500 calories/hr, the same rate as playing tennis. The American Heart Association and other medical groups recommend gardening and lawn care activities as part of a healthy life style.

Daily contacts with natural landscapes around homes create a healthy family atmosphere. The National Gardening Survey (Butterfield 2000) reports that 64% of U.S. households, or 67 million, participated in one or more types of indoor and outdoor lawn and garden activities in 1999. People give many reasons for gardening, including increasing property value, completing required yard maintenance, and having a hobby. In an earlier study (Relf, McDaniel, and Butterfield 1992), 37% of participants said that gardening provided a sense of peace and tranquility,

Figure 5.2. Gardening can be enjoyed by persons of all ages. Photo courtesy of the American Horticultural Therapy Association, Denver, Colorado.

and 24% said that it gave them a sense of control over their immediate environment. Forty percent reported that being around plants helped them feel calmer and more relaxed, and 46% said that nature was essential to their well-being (Figure 5.2).

Urban plant communities increase worker productivity. Small increases in job satisfaction and productivity can have significant effects on the net profit of a business. Several studies of interiors with windows have documented people's greater preferences for views with vegetation or nature than for "visually impoverished" alternatives (Markus 1967; Verderber 1986). Kaplan and colleagues (1988) reported that workers with a view of natural elements, such as trees and flowers, experience less job pressure, are more satisfied with their jobs, and have fewer ailments and headaches than those who have either no outside view or can see only built elements from their windows. The mere knowledge that a view is available is important to employees.

Community Quality of Life

Appropriate use of natural and landscaped areas in urban environments can foster a variety of quality-of-life benefits, including enhanced social functions, community cohesion, pride of ownership, and sense of place. Only with a thorough knowledge of the total agroecosystem and its history, including an understanding of the people, will it be possible to optimize natural, built, planted, and human resources. For example, cities situated along waterways can capitalize on scenic amenities and existing climatic conditions. Understanding the effects of the human-altered environment (e.g., atmospheric and soil pollution, heat islands, soil compaction, and water availability) on urban plant communities is crucial to maintaining their longevity. Understanding the contributions that natural areas provide to the community (e.g., air filtering, temperature buffering, wind diversion, and psychological benefits) is equally important. Knowledge of communities' cultural patterns and social structures also ensures that built, planted, and natural areas contribute to supportive social relationships and overall quality of life.

Figure 5.3. Residents enjoy their community garden at the Northpoint Apartments in Mt. Olive, North Carolina. Photo by Ken Hammond, U.S. Department of Agriculture.

Gardens built and maintained by community residents provide opportunities for residents to exert control over their neighborhood so that it can be a source of pride (Figure 5.3). Because people create these gardens, they serve as a mechanism for both work and social life (Francis 1987). According to Feenstra and colleagues (1999), positive effects of community gardens include enhanced neighborhood cohesion and trust, decreased racial discrimination, increased numbers and quality of neighborhood associations, and enhanced civic participation among gardeners. Gardeners also connect with members of different groups with which they may not normally come into contact.

In urban tree-planting programs, sociological factors may be more important than biological factors in tree survival. Public works plantings that have no involvement from the community in planning or installation may lack grassroots support and be open to local action to subvert efforts. For example, as part of one model city's program, officials planted 2,000 trees, few of which were standing two years later. With community involvement, tree survival increased and many human benefits resulted, such as enhancement of the sense of community, a positive social identity for participants, increased personal identification with the neighborhood, and personal control over the neighborhood (Ames 1980).

Planted landscapes in public housing neighborhoods foster warmer human relationships, less verbal and physical aggression, less violence, and improved parenting and child development. Among older adults, spending time in planted outdoor spaces also is related to stronger social integration and sense of community (Kuo and Sullivan 1996). Evidence suggests that the public prefers the undeveloped character of natural areas on the urban fringe. At the same time, it is important that these places look maintained. There is support for lower cost, and often for more sustainable maintenance practices, and users are often willing to help maintain landscapes.

In fact, user involvement yields many benefits. Ecological restoration generates satisfaction, and neighborhood greening strengthens communities (Kuo and Sullivan 2001). Landscapes and gardens may help individuals to overcome social isolation, as exemplified by plant societies and shows, which provide opportunity for people to share interests.

Community gardens can decrease crime. Feenstra and colleagues (1999) and Littman (1996) reported that community gardens decreased crime and vandalism in Philadelphia. In one Philadelphia neighborhood where residents participated in a community greening program, a 90% decrease in neighborhood crime occurred (Macpherson 1993). In the Mission District of San Francisco, residents documented a 28% drop in crime after the first year of their garden project (Malakoff 1995). In parts of Los Angeles, community gardens were one of the few things to survive the 1992 riots. Kuo and Sullivan (1996) found that green space areas play an important role in community safety by decreasing the incidence of vandalism, litter, and graffiti, and that people living adjacent to densely planted areas feel an enhanced sense of safety (Kuo and Sullivan 2001).

Appropriate planning and landscape design can moderate and manage traffic, improve pedestrian safety, and facilitate decreases in crime and violence. *Traffic calming* is accepted widely as a technique by which landscaped circles and speed control mechanisms slow traffic and reclaim streets for pedestrians and neighborhoods. In Seattle, the city's traffic calming program has decreased pedestrian accidents by more than 75% (Lockwood and Stillings 2001). Streetscaping techniques in conjunction with traffic calming manage traffic effectively by decreasing speeds of cars, collision frequency and severity, cut-through traffic, and need for police monitoring. In addition, they can promote quality of life, pollution reduction, water infiltration, and improved visual aesthetics of street environments (Lockwood and Stillings 2001).

The design and maintenance of outdoor spaces influence public health, social interactions, daily stress, and quality of life. The Local Government Commission (2001) reports that, in recent years, public health professionals are recognizing that well planned and built communities have an effect on the health and well-being of U.S. residents. In fact, the Centers for Disease Control and Prevention attribute a sedentary life style, in part, to current land-use and transportation patterns. Studies have found that individuals are more likely to engage in the required amount of moderate physical activity if they can incorporate it into their daily routine. As a result, public health professionals are emphasizing the need to build communities that encourage people to exercise and to garden. Researchers report benefits such as increased self-esteem, pride, confidence, personal satisfaction and efficacy, and a sense of stability among gardeners (Blair, Giesecke, and Sherman 1991; Feenstra, McGrew, and Campbell 1999; Pothukuchi and Bickes 2001). Several studies also have attested to the increased satisfaction with the quality of gardeners' lives (Waliczek et al. 1996) and community spirit (Littman 1996).

These projects also offer youth and other members of marginalized groups opportunities to develop leadership abilities. In Boston, Massachusetts, for example, youth who participate in The Food Project "learn what a season is, what a cycle is, that it takes time to go through a season and your own inner development"

Figure 5.4. Assisted by staff from the Chicago Botanic Garden, Chicago public school students work in a teaching garden. Photo courtesy of Chicago Botanic Garden, Glencoe, Illinois.

(Lazarus 2000). Gardens provide experiences that help children develop a better self-image, respect for property, patience, analytical thinking, trust in cycles, remorse, pragmatic acceptance of failure, and opportunities for improvement (Figure 5.4).

The character of a place affects both residents and visitors and is important to business communities because it influences consumer choices. In a study of revitalizing districts in eight U.S. cities, both business people and residents gave higher ratings to scenes with trees. An orderly and well-maintained planting scheme of both trees and accessory vegetation produced the highest visual quality ratings. Consumers who rated three hypothetical business districts indicated significantly higher scores for districts with street trees and other landscape improvements. Amenity and comfort ratings were approximately 80% higher for a tree-lined sidewalk than for a nonshaded street. Quality of products purchased was rated 30% higher in districts having trees than in districts with barren sidewalks (Wolf 1998). The following factors have been documented as positive outcomes of planted urban landscapes: customer patronage and higher commercial land values, occupancy rates, and property values (Bradley 1995; Dwyer et al. 1992; Orland and Ebreo 1992).

Access to nature is important to life satisfaction (Fried 1982) and to neighborhood satisfaction (Frey 1981). Detroit residents reported that parks and street trees were second only to education in the perceived value of municipal services (Getz, Karow, and Kielbasco 1982), and retirement community selection is associated with well-landscaped grounds (Brown 1992).

Community Food Systems

A *food system* consists of all of the steps involved in putting food on the table (e.g., growing, harvesting, processing, packaging, transporting, marketing, consuming, and disposing). A *community food system*, often promoted as an ideal, aims to integrate all the processes or steps enhancing environmental, economic, social, and individual health. A food system may be simple, complex, local, global, or regional. There are four qualities, however, that distinguish a community (sometimes referred to as "local" or "regional") food system from the global food system, the latter being the source of most U.S. food. They are

- concern for food security;
- proximity or distance between system components (the producer and consumer are usually closer together);
- self-reliance (the community's attempt to meet its own food needs); and
- sustainability of the system (e.g., when farming practices are less reliant on chemicals and fertilizer, when residents take an active role in food system planning, and when a strong market exists nearby to ensure a reasonable return for those involved [Wilkins 2000]).

The United States is experiencing increased public interest in local and regional food systems (Clancy 2000; Integrity Systems 1997). This public interest is driven by a number of factors including farmers' desires to capture a greater share of the profit by marketing direct to the customer, customers' demands for more knowledge about the source of their food and its production methods, and growing public interest in establishing a relationship with the farmers who produce their food. This interest also may coincide with people's need to re-establish a sense of community and a connection with their rural heritage. Nonprofit organizations and the media are expressing concern about the state of the family farm, the effect of corporate farming on physical and spiritual health and on the health of local communities, global and domestic food security, and the need for a closer connection between rural and urban communities and policies. The food system may be a mechanism for bringing certain diverse interests together to achieve a more sustainable future.

There are other reasons for the growing interest in a more localized food system. Urban food systems are more adaptable and mobile than industrialized systems. As cities expand physically, the boundaries between what is urban, *periurban* (urban edge), and rural are blurring, thus creating new opportunities. Consumers are placing greater value on freshness and flavor and on personal health and safety. Diets tend to improve when family members or children are involved in producing and preparing their own food. When farmers have access to consumers, as in or near MAs, high-value products also can add significantly to income.

This fact is substantiated by gross returns at farmers' markets, which typically are 200 to 250% greater than those at wholesale fresh markets (Integrity Systems 1997). Another stimulus for change in the U.S. food system can be traced to fears of terrorism and the perceived threat of global food contamination. Only time will tell whether the terrorist events of 2001 will have a significant effect on consumers' desires to access foods originating close to home.

Urban food systems, a global phenomenon, are sources of products valued in the tens of millions of U.S. dollars (USD) annually in less developed countries. Despite the difficulty of characterizing the location (urban, suburban, periurban) of these activities, there is general agreement regarding the important role that agriculture plays in adding to the food security of poor households within and around cities. Urban food systems enhance household and community income, contribute to environmental protection and conservation, serve as educational tools, and improve the nutritional status of children. Urban agriculture also includes, in addition to food, ornamental and agroindustrial plants, silk worms, tobacco, aquaculture, and other noteworthy economic activities (Mougeot 2000).

In Cairo (Egypt), almost 30% of low-income households were found to keep livestock estimated to be worth nearly one month's income. In Sofia (Bulgaria) in the late 1980s, private urban farms supplied the city with 48% of its milk and eggs, 53% of its potatoes, and 50% of its vegetables. In West African cities such as Dakar (Senegal), Kumasi (Ghana), Lome (Togo), and Bissau (Guinea-Bissau), food production systems have been growing, as has the amount of land used for this purpose, with correspondingly higher yields. In Havana (Cuba) and Cagayan del Oro (Philippines), small livestock systems are growing faster than plant-based systems. Several studies of urban agriculture in Kenya have been conducted, one of which calculates the value of Nairobi farmers' 1987 annual (two-season) off-plot crop production at 4 million USD. Few studies have documented the direct economic contributions of urban agriculture to the city systematically, or to the rest of the urban economy (e.g., through inputs and human resources associated with fencing, storage, transportation, and processing [Mougeot 2000]).

According to the Food and Agriculture Organization (FAO) (1999a), commercial periurban livestock production represents 34% of world meat production and almost 70% of worldwide egg production. The efficiency of horticultural crop production is attractive when land and water resources are limited. Using vacant land, recycled water and waste, and family labor, as well as preserving self-produced food also are attractive practices. Almost 90% of households that engage in urban agriculture are estimated to preserve and store some of the food produced. Use of recycled wastewater that is not treated for food production carries some risk; when properly managed, however, the risk is minimal. Additional challenges include water quality issues associated with urban aquaculture (see section on Aquaculture in Chapter 4) and land availability and security.

Based on 1993 estimates, 800 million people in the world are engaged actively in urban agriculture. In 1995, urban areas produced between 15 and 20% of the world's food. By the time half the world's population is urban, half of the food consumed in cities will have urban sources (Smit 1996).

Community food systems, which may be found in rural and urban areas, provide an alternative to the more industrialized, high-volume food systems. They involve a direct connection between the producer and the customer through such activities as entrepreneurial gardens, farmers' markets (Figure 5.5), community supported agriculture (CSA), farm-to-table programs, u-pick and roadside stand operations, and neighborhood food buying clubs. The next sections will discuss CSAs, entrepreneurial gardens, farmers' markets, and farm-to-table programs.

Figure 5.5. An abundance of fresh vegetables is offered for sale at a weekly farmers' market. Photo by Bill Tarpenning, U.S. Department of Agriculture.

Community Supported Agriculture

Community Supported Agriculture, a relatively new production and marketing system, is a way for suburban, urban, and rural residents to support a farm operation directly. Consumers buy shares in a farm at the beginning of the season in exchange for farm products throughout the season. Producers provide a weekly food supply consisting typically of organic produce and sometimes including milk, cheese, eggs, meat, honey, plants, and other farm products. Products may come from the farm with which there is a contract or through a cooperative arrangement with neighboring farms that have different products.

Because the CSA consumers share the overall risks

of the operation in exchange for a share of the harvest, they often are called *sharers*, or shareholders. Sometimes sharers work on the farm during the growing season. The CSAs depend on the active interest of consumers. Customers become shareholders because CSAs are a source of fresh produce (often organic); because of the value they place on a healthy growing environment; and because they want to support local farmers. Customers also appreciate knowing how and where their food is grown and the opportunities to participate in a food community, to connect to the land, and to teach their children about the land.

The CSAs often provide other benefits to further the connection between urban and rural life. Some decrease the price of a share in exchange for labor or offer farm tours, special events, and seasonal celebrations to involve sharers and their families in farm life. Some CSAs have broader human services agendas and donate excess food to low-income or nutrition programs. For example, in Hadley, Massachusetts, a Food Bank started its own CSA. Every year the farm donates tens of thousands of pounds of fresh food to programs feeding hungry and homeless people (Butler and Carkner 2001).

Certain CSAs go even further, combining low-income food assistance with training programs. Since 1978, the Hartford Food System (HFS) has offered solutions for the city of Hartford, Connecticut's food problems. They organized a farmers' market, the first of 48 across the state. Along with the Women, Infants, and Children (WIC) program, the Connecticut Department of Agriculture, and other agencies, the HFS helped launch the Connecticut Farmers' Market Nutrition program, which now provides more than 50,000 WIC recipients with nearly $400,000 of coupons that they can redeem at farmers' markets to buy fresh produce. They also helped expand this program to senior citizens.

And, in 1993, after many years of creating links between farmers and low-income consumers, the HFS joined the Friends of Holcomb Farm Estate to create a CSA. Their goal was to create a CSA from which half of their 16 a. of fruits and vegetables would go to low-income Hartford residents and community organizations. For every 5 a. cultivated, Holcomb Farm provides two shares to local social services. As a result, the YMCA Youth Shelter became involved with the farm and started a farm stand. Teenage girls that are served by the shelter sell vegetables and homemade products such as salsa. They gain retail experience and earn money for other activities. Another nonprofit group devoted to rebuilding Hartford's North End gives out CSA shares through 17 block clubs. Inner-city youth teams have helped plant, weed, and harvest crops at Holcomb Farm (Henderson and Van En 1999)

The CSAs are both a social and a nutritional outlet. Because their supporters are very committed and their numbers are increasing rapidly, they often consider themselves part of a social movement. In the United States, the movement began on Robyn Van En's Massachusetts farm in 1985, when a friend returned from Switzerland and told her about his experience working with a group of Swiss farmers. Van En was so taken with his account that she launched her own CSA and announced the idea of "share the costs to share the harvest" (Henderson and Van En 1999).

A CSA-equivalent operation first was developed by a group of women in Japan in 1965 who were concerned about "pesticides, the increase in processed and imported foods, and the corresponding decrease in the local farm population" (Henderson and Van En 1999, xvi). They approached a local farmer and created a cooperative agreement to support the farm operation in exchange for a share of the harvest. Thus, the distant origin of the U.S. CSA is the *teikei* movement in Japan. Currently, Japan has more than 600 producer-consumer groups, which supply food to more than 11 million people (University of Wisconsin–Madison 2001).

Introduced into the United States in 1986, community supported farms now are estimated to number approximately 1,000 in the United States. The fact that in 1996, the 65 CSAs in Wisconsin produced food for an estimated 3,000 households exemplifies their effect on urban and suburban households. But CSAs are such a recent development in the U.S. food and agricultural system that little formal documentation about their effect exists. Given their rapid acceptance, however, it is possible that they will follow the farmers' markets movement, filling a niche for urban consumers hungry for a closer connection with farming and the land.

Entrepreneurial Food Gardens and Farms

Agriculture in the United States is taking on a new look. The change is driven by such factors as farmers' needs to retain more profit, public concern about potentially negative effects of farming on the environment, and family efforts to engage in more satisfying life styles. As a result, farmers (and gardeners) are becoming increasingly entrepreneurial. For example, they are adding value to their products by marketing processed products or by selling a special product

identity with more customer appeal. Some entrepreneurs are using innovative direct marketing strategies or forming alliances with other farmers or members of the value chain (processors, distributors, retailers). They are cutting costs, decreasing their dependency on off-farm inputs (purchased fertilizer, pest control, seed, or labor), or growing organic products. Some are finding that farming or gardening can be more economical and more satisfying when done in harmony with the natural ecosystem (USDA 2001c).

As stated earlier (Chapter 2), vacant urban land can be a resource for urban gardens and farms. Urban farms and garden enterprises employ a variety of marketing models including neighborhood farmstands, CSAs, cooperatives, direct sales to grocery outlets and to institutions, value-added processing and sales, and sales at farmers' markets (Feenstra, McGrew, and Campbell 1999). Urban farms seem frequently to require heavy infusions of funding to support startup activities, and they may achieve only marginal profitability. Feenstra and colleagues (1999) found that of the 23 projects providing enough information to allow calculation of a *self-sufficiency index* (the percentage of total program expenses covered by sales), 19 (83%) projects had a self-sufficiency index of less than 50%. Only four (17%) of the projects were at least moderately self-sufficient. Gross sales of gardens in one study differed widely; 70% of gardens, however, sold less than $25,000/yr. For the gardens that currently exist, market sales tend not to be a high priority, a fact that may be explained by the difficulties gardens face. A 1999 study of members by the American Community Gardening Association (ACGA) found that they ranked "entrepreneurial enterprises" ninth out of ten important garden characteristics (Feenstra, McGrew, and Campbell 1999). Gardens, however, provide multiple benefits for individuals, households, and communities in ways that are measured less easily.

Although many urban gardens are owned privately, most are found on unused public land and in communities where there is a shortage of public parks and safe gathering places. Urban community gardens frequently are developed on unwanted land that has been a dumping area for waste of all kinds. In communities such as New York City, Philadelphia, and San Francisco, community gardens are viewed as a civic resource in the sense that they contribute beauty, security, and neighborliness, but they also contribute economic and physical sustenance and a range of social services. One of the dilemmas facing community gardens is how to protect these areas from development. For example, the gardens of New York City (there are more than 700 sites) are seen by city government as a potential source of tax revenue, whereas neighborhoods view them as valuable open spaces (Gowda 2002).

Through the sale of locally grown product and value-added products, community gardens help circulate money locally and strengthen networks among and between neighborhood groups, local businesses, local governments, and nonprofit organizations. Feenstra and colleagues (1999) found that local businesses were hiring community garden project participants for new jobs or contributing financial resources in exchange for goods and services provided by these projects (e.g., fresh produce, landscaping, and nursery work). When urban gardeners/farmers sell directly to consumers, they earn more than they do when selling to an intermediary or a redistribution center.

As urban populations expand, opportunities for nearby farmers to grow new types of crops and to market them in more creative ways (e.g., to restaurants, grocery outlets, roadside stands, and u-pick operations) also expand. Heimlich and Anderson (2001) and Heimlich and Barnard (1997) categorize metropolitan farms as one of three types:

- *Recreational farms*, which sell less than $10,000 annually, consist of fewer than 100 a., and require little daily management;
- *Adaptive farms*, which sell $10,000 or more annually of high-value products making up one-third of sales with more than $500 in sales/a., necessitate intensive labor and input management on 100- to 200 a., and operate as a business exclusively or with other enterprises;
- *Traditional farms*, which sell $10,000 annually of high-value products making up one-third or less of sales with $500 or less sales/a., or conventional livestock and/or crops that make up more than one-third of sales, consist of more than 200 a. (the largest of the three types of farms), and necessitate extensive management rather than intensive management, and little off-farm employment.

In 1997, recreational farms were estimated to account for 16 to 18% of U.S. farms, yet they contributed only 1% to aggregate U.S. sales of agricultural products. They accounted for 51 to 54% of farms in MAs and controlled 29 to 30% of farm sector assets and equity and 14 to 17% of land in operation. Recreational farms tended to survive less frequently than adaptive farms. Adaptive farms, which seem the best survivors of the three types, accounted for 13 to 14% of metropolitan farms and 9 to 12% of metropolitan

farm acreages in operation. Traditional farms, making up one-third of metro farms, operated 71 to 77% of metro farm acreage and controlled more than 40% of assets, sales, and net cash income. Like recreational farms, however, they had a lower survival rate than adaptive farms (Heimlich and Anderson 2001).

Entrepreneurial gardens and farms provide amenities that are not always measured in economics terms. As communities become more built up and congested, farmland often is valued for scenery and recreational opportunities such as hiking and bird watching and for the satisfaction that comes from knowing land is protected. Studies have indicated that people are sometimes willing to pay about $150 each to preserve an acre of farmland when its potential replacement is high-density development, but only $50 if low-density development is the potential replacement (Heimlich and Anderson 2001).

If the farm or garden is a u-pick operation where customers procure home-grown fruit or vegetables, the customer may find the produce a bargain but the farmer may only break even. According to the USDA study conducted by Integrated Systems Cooperative Co. (1997), u-pick prices average about half those in retail stores. If a farmer pays the cost of strawberry picking labor, for instance, there may be little advantage in selling direct to the customer. The same study noted, however, that sustainable community food distribution systems have a clear advantage over industrial food systems because costs for the former typically are lower for such things as transportation, promotion, broker/distribution fees, warehousing, financing, and packaging. Community food system distribution costs usually are higher for start-up marketing and distribution, and for labor.

On December 20, 1999, the USDA adopted rules by which certain foods may be certified as organic. Consumers who want to buy organic foods can do so now with reasonable assurance that the product is organic. Farmers or gardeners who want to produce for this specialized market can do so knowing that all others will be held to the same standard. Sales of organic foods have grown at least 20%/yr in the 1990s and now amount to nearly $8 billion/yr (Brasher 2000). These new USDA rules implement the Organic Foods Production Act of 1990, improving earlier language that did not identify genetically altered or irradiated foods adequately and bringing a degree of consistency to the national organic marketplace. A producer wishing to be certified must have periodic inspections and maintain extensive records. Organic production systems emphasize use of compost; thus a waste stream becomes a valued nutrient source. The organic label is an important part of the marketing chain, permitting both producer and consumer to express a product preference.

Increasingly, farmers are using labels to identify particular product attributes that appeal to customers. Labels convey information to a buyer, enabling the customer to exercise discretion in purchase. In this way, the buyer is able to purchase the bundle of product qualities that she/he wants, such as organically grown strawberries, free-range chickens, naturally raised pork, or environmentally friendly lumber produced with sustainable practices. Labels broaden opportunities for farmers and consumers alike, creating additional points of contact and greater understanding between the two groups. Labels help farmers separate their products from the homogeneous generic varieties found in supermarkets or mass discount markets. Labels can help consumers buy from local farmers, expressing direct support for what their neighbors are doing. Labeling often is employed as an official instrument of policy, enabling customers to purchase a greater level of food safety or quality if they prefer but permitting other buyers to purchase at the lowest price without those unique product attributes. Customers are willing to pay for certain food quality characteristics or special-process attributes (Caswell 1998).

An example that combines several of these methods is used by Stahlbush Island Farms, Inc. in western Oregon. The company has built its market by assuring buyers that vegetables produced on its farms are raised according to sustainable, "green" farming practices, which means certified organic for many products and minimal pesticide use, rotational practices, nutrient management, and ground-water protection measures for the others. Persons buying sweet corn or broccoli from Stahlbush know that the farmer is making a special effort to protect the environment and their families' health. Stahlbush farming practices are communicated to buyers. In fact, buyer preferences completely drive production decisions. Buyers generally sign a contract with Stahlbush before the crop is planted. The farmer team invests heavily in the latest information and technology consistent with members' production philosophies. Theirs is not a small farm, but an industrial one with a different approach to production and customer relations, which is based on labeling (Chambers and Eisgruber 1997).

Agriculture has been associated, typically, with traditional food and fiber production practices. With continued increases in available resources, in awareness of conservation and resource preservation, in

internationalization of the population, in use of waste recycling, in leisure time, in concern for quality of life, and in demand for companion animals, more opportunities for marketing innovative products exist than ever before. Among the areas with potential are specialized ornamental or green industry crops, seed production (e.g., wild flower and native plants), potting media ingredients, forest products (wild crafting), pets (e.g., rabbits, snakes), specially trained dogs, compost and soil microorganisms, worms, bugs, and other gardening or fishing aids. With the interest in restoration and amelioration of the natural environment, more opportunities for plants for highway revegetation, wetlands, native sites, riparian restoration, and meadows exist.

Also of interest are products derived from nontimber urban forestry and horticultural products (NTUFHP). Products generated for cash and barter include lumber, pulpwood, hobbyist woods, fruits, nuts, mulch, composting materials, firewood, and nursery plants. Through interviews and observations, 163 urban forest products were documented in Baltimore, with at least 103 products from 78 species (Community Resources 2000). Additionally, phone interviews documented 57 products collected in Philadelphia and 26 fruit and nut products collected in Boston. These 103 NTUFHPs included edible (43%), medicinal (8%), horticultural or nursery (31%), and decorative and craft (18%) products. In addition to the direct economic value of NTUFHPs for personal use, NTUFHPs and the NTUFHP collection process provided recreational, nutritional, educational, and cultural benefits to collectors. The estimated annual economic value from product-producing trees ranged from $4/yr for an average mulberry tree to more than $100/yr for average apricot, Chinese chestnut, and peach trees. The average annual value for product-producing trees quantified in this study was $50/tree/yr.

Farmers' Markets

A *farmers' market* is a gathering place where two or more farmers come together to sell their products directly to consumers, often from the back of trucks or in specially constructed stands. Many markets are seasonal "open air" markets, operated outdoors and often in public spaces (Figure 5.6). Farmers' markets offer a regular outlet where vendors sell a variety of local agricultural products ranging from fresh fruits, vegetables, and flowers to honey, plants, meat, cheeses, eggs, Christmas trees, and value-added products such as pickles, jams, candles, or dried fruits. Farmers' markets were a common venue before World War II, after which they declined when refrigeration, improved transportation, and supermarkets changed the face of food retailing in the United States. Farmers' markets enhance peoples' direct contact with agriculture in their own cities and towns. For inner city residents living in neighborhoods too poor to support a supermarket, farmers' markets can be one of the few places that residents buy fresh fruit and vegetables (Abel, Thomson, and Maretzki 1999).

In the past 20 years, the number of farmers' markets has increased dramatically in the United States. In 1980, the USDA reported fewer than 100 farmers' markets in operation. By the 1990s, they had grown in such great popularity that the Agricultural Marketing Service (AMS) of the USDA began collecting data on them in 1994. According to the USDA (2001a), there has been a 63% increase in the number of farmers' markets during a six-year period (1994 to 2000), from 1,755 in 1994, to 2,410 in 1996, and to 2,866 in 2000. The 2000 *National Farmers Market Directory* documented more than 2,800 farmers' markets in the United States. Consumer acceptance of this marketing mechanism is a clear indication of the integration of farmers' markets into the rural-urban continuum. Farmers markets' are important revenue sources. In 2000, 19,000 farmers sold their produce only at farmers' markets. Eighty-two percent of farmers' markets are self-sustaining; 58% of markets participate in WIC coupon programs or local and/or state nutrition programs; and 25% of markets take part in gleaning programs that distribute food and food products to needy families (USDA 2001a). Their renaissance is striking testament to the value of farmers' markets to the

Figure 5.6. The Crescent City Farmers' Market meets in New Orleans, Louisiana, every Saturday morning. Photo by Bill Tarpenning, U.S. Department of Agriculture.

contemporary public.

People like to shop at farmers' markets for many reasons. The findings from farmers' markets studies carried out in Canada, the United States, and the United Kingdom clearly identified the benefits of farmers' markets for farmers, the local economy, consumers, and the environment. For example, according to Bullock et al. (2000), farmers' markets generate the following consumer benefits:

- Their prices can be equal to and sometimes below those in grocery stores.
- They facilitate consumer-farmer connections and therefore represent a valuable aspect of community culture.
- Their food offerings are of higher quality.
- Their food offerings are more diverse (Figure 5.7).

Figure 5.7. A soil conservationist and a graduate student at Fresno State University check on the growth of Asian vegetables that will be sold at local farmers' markets. Photo by Bob Nichols, U.S. Department of Agriculture.

- They promote a desire for "home grown" food.

Farmers' markets benefit the local economy by

- enhancing economic development through safeguarding local jobs, diversifying the economy, and facilitating business expansion;
- retaining money in the community;
- strengthening links between local business, and bringing in additional trade dollars to other stores in the same area (knock-on trade); and
- serving as a magnet for tourism.

Farmers' markets benefit farmers by

- helping them survive economically by earning higher prices and profits;
- serving as major sources of revenue;
- helping farmers gain new skills; and
- expanding marketing networks (e.g., schools, hospitals, senior citizens centers, and others).

Farmers' markets benefit cities and towns by generating additional local economic activity and helping keep food dollars at home (Abel, Thomson, and Maretzki 1999; Lev and Stephenson 1998). The Oregon farmers' market study found that the vast majority of consumers came because of the market and would not otherwise have been downtown. But once the farmers' market drew them there, they did additional shopping or eating. According to Lev and Stephenson (1998), the hypothesis that farmers' markets bring additional dollars downtown is strongly supported by the data. The data also are supported by other studies in other regions. For example, one-third of shoppers at Wisconsin farmers' markets indicated they combined other activities such as shopping and dining with visits to the market (Cottingham et al. 1994). The New York City Greenmarkets program is said to be responsible for $20 billion in new investment in and around Union Square (Farmers' Market Trust 1999). The historic Pikes Place Market in Seattle, Washington has developed an international reputation as a major tourist attraction.

In a 1999 survey of Maine farmers' markets, customers indicated that the second major reason (after product quality) that people shopped at farmers' markets was to support local farmers (Lockeretz 1986). A survey of three English farmers' markets found similar results: 79% of respondents indicated they shopped at farmers' markets to support small farmers; 68% were motivated because the farmers' market was different; 62% because of the freshly harvested/made products; 57% because of the availability of

organic produce; and 45% because of the good quality of the products (Wilson, J., reported in Bullock et al. 2000). Farmers' market customers also cite the farmers' market atmosphere as a primary attraction. Customers appreciate the opportunity to get acquainted with the person who produces their food, to learn about new foods and food preparation, and to become involved in the entire farmers' market experience (Abel, Thomson, and Maretzki 1999; Lev and Stephenson 1998; Lockeretz 1986).

The Ithaca, New York, farmers' market is a good example of this type of business. The market opened first for business in 1973 as a venue in which local growers and craftspeople could sell their goods. It expanded rapidly and moved five times before market volunteers transformed a site of former debris into a thriving community-gathering place called Steamboat Landing. Now the farmers' market is located permanently on the waterfront where steamboats from Cayuga Lake used to dock. Visitors shop for fresh, local produce and handcrafted gifts. Customers sit at tables along the waterfront listening to music while savoring a wide variety of international foods. Recently a dock was built to accommodate local fishermen, people arriving by boat, and those wanting to picnic in a picturesque spot. In the summer, 125 vendors sell at the Ithaca farmers' market on one or all of three market days. The market often draws more than 5,000 people a day and sales in 1999 neared $4 million. What originally was an innovative way to sell local produce, crafts, and baked goods now is an Ithaca tradition.

Health conscious consumers have spurred the revival of farmers' markets, demonstrating a desire to purchase the freshest produce. The tremendous growth in farmers' market attendance may be partly due to consumers who have become increasingly interested in nutrition, food and environmental safety, and the use of agricultural practices that contribute to improved public health.

In numerous surveys, shoppers ranked freshness as their main selection factor when buying produce and their primary reason for choosing farmers' markets (Abel, Thomson, and Maretzke 1999; Lockeretz 1986). An Ohio study found that consumers want freshness, quality, convenience, selection, and value when selecting fresh produce, and roadside stands or farmers' markets are perceived as the best source of produce with these features (Rhodus, Schwartz, and Hoskins 1994). In taste test studies, beyond freshness, the appearance, nutritional value, and the fact the products were locally produced were listed as reasons people shopped at farmers' markets (Abel, Thomson, and Maretzki 1999).

Consumers were willing to pay more for local products than for similar products at a supermarket. In a 1998 Oregon study, approximately half the respondents to a mail survey said they were willing to pay some premium for a locally produced product, whereas 80% of consumers shopping at farmers' markets indicated they would pay a premium over similar products at a supermarket. In the same study, 30% of customers indicated that they buy local products because of "the enjoyment of the buying experience," and 44% rated "supporting the local economy" and "keeping farmers in the local area" as highly as "local products are better" (Lev and Stephenson 1998).

Farmers' markets give people, through direct connections to farms, a contact with rural life and with their food system. These markets foster relationships between consumers and the people who grow their food and promote understanding about food production.

In an effort to make locally grown food in Massachusetts farmers' markets more available and affordable to low-income consumers and to increase the consumption of fruits and vegetables by nutritionally at-risk women and children, the Massachusetts Department of Food and Agriculture initiated a program with the Federation of Massachusetts Farmers' Markets in 1986. It quickly gained in popularity, and in 1992 the USDA established the WIC Farmers' Market Nutrition Program to provide fresh, nutritious, unprepared foods from farmers' markets to WIC participants and to expand the awareness and use of farmers' markets by consumers. Federal funding in 2000 doubled to $12 million.

Seventy-five to one-hundred million dollars in food stamps are estimated to be spent at farmers' markets annually; farmers' markets also support gleaning programs, donations to food banks and shelters, and sales to school meal programs.

Farm-to-Table Programs

Farm-to-table programs connect farms directly with restaurants, schools, or other institutions that feed large numbers of individuals. These programs, often initiated through a small grant, have evolved in an effort to return a greater share of the food dollar to the producer. For example, the Practical Farmers of Iowa collaborate with several local organizations through the Community Food Systems Project, through which they broker purchases of local and sustainably produced foods for hotel and restaurant customers, conference caterers, and institutional

markets. The program, which initiated an Iowa Choice menu, offers its services to university conferences and catered meals. The major challenges associated with this type of program are keeping retail prices sufficiently low to encourage continuing customer demand, and ensuring continued patronage from institutional buyers who are asked to pay a fee for "brokering" services offered by nonprofit organizations. One of the future challenges for farm-to-table programs is to find ways to encourage state, local, and federal institutions (e.g., prisons, agencies, hospitals, and schools) to purchase directly from farmers, thereby supporting their own state, local, and regional farming systems.

Farm-to-school programs link schools' food purchasing and planning in a "healthy farm, healthy kids" approach. Young people benefit through being offered additional choices in healthy foods and improved nutrition, and the program decreases the commercial influence on school food choices. Additionally, this mechanism offers new markets and better prices for local farmers (Azuma and Fisher 2001). All students, especially those relying on free or low-priced meals, can benefit from improved nutritional quality as well as from educational programs on local agriculture, nutrition, and food systems. A seven-case study by Azuma and Fisher (2001) found there were substantial barriers associated with farm-to-school programs (e.g., additional costs for labor and food, and administrative and logistical challenges). Federal, state, and local policies need to be designed to support local food purchases by schools and other institutions.

6 Recreation and Leisure

Introduction

Large segments of the recreation and leisure industry are related directly to products and services of traditional and urban agriculture activities. Agricultural services today support a variety of indoor and outdoor educational, recreational, and leisure pursuits including, but not limited to, gardening, golf, hiking, equestrian activities, wildlife viewing, bird watching, and visits to tourist attractions and scenic areas, such as public parks and botanical gardens (Figure 6.1). Many activities are of significant economic importance to local communities. Moreover, traditional farm businesses are diversifying their operations to attract visitors for educational, recreational, and leisure activities. This chapter has four goals: (1) to illustrate the contributions that traditional and nontraditional agricultural services and products make to recreational, leisure, and tourism industries; (2) to identify new opportunities for economic diversification of traditional farm production businesses; (3) to highlight the interdependency between urban and farm populations as it relates to tourism, recreation, and leisure activities; and (4) to reinforce the need for farmers to develop mutually beneficial educational, recreational, and tourism partnerships with urban communities.

On-Farm Recreation and Entertainment Farming

Farms provide many opportunities for outdoor recreation and rural renewal. Farmers can create revenue by charging fees for on-farm visits and activities. Fee charges can be collected for hunting, hiking, bird watching, mushroom gathering, and other direct consumer services of the farm itself that do not involve the primary food or fiber product. Some farm families carry this concept further by becoming a bed and breakfast or contracting with special groups for experiences, such as painting/music on the farm, events (e.g., maple sugar making), or even "dinner in the herb garden" or "bar-b-que in the barn." Building tourist attractions, such as "the Amazing Maize Maze," is appealing to some farmers.

In other instances, people experience the traditional farm by just being there. A visiting family may buy gift packs of fruit or homemade jam, select a pumpkin for Halloween, enjoy a hayride, or view animals or ornamental trees and flowers in production. Agricultural educational events include school tours, seminars, classes, gardening schools, and other offerings

Figure 6.1. Visitors to the Chicago Botanic Garden enjoy a stroll through Sansho-En, the Japanese Garden. Photo by Bill Biderbost, courtesy of the Chicago Botanic Garden, Glencoe, Illinois.

through which the group is expected to take away new knowledge and skills regarding agriculture. All these farm experiences or services can compete with other forms of recreation and bring urban people closer to farms and to farmers.

There are economic benefits of wildlife habitat on the farm. The Conservation Fund cites significant findings regarding the economic value of several outdoor activities that could be well managed on farms (Conservation Fund 2002). The fund reports that U.S. residents spend $18 billion/yr to watch wildlife, triple what they spend on movies or sporting events. Birdwatchers spend $5.2 billion/yr according to studies by the U.S. Fish and Wildlife Service. A study of the Santa Ana National Wildlife Refuge in Hildago County, Texas, found that birdwatchers visiting the refuge added $14.4 million to the local economy. A similar study found that birders spent $9.7 million on their hobby while visiting Virginia's Chincoteague National Wildlife Refuge. According to a 1994 Roper Survey on Outdoor Recreation, fishing is the favorite recreational activity among men (19%). In 1991, anglers spent $24 billion, or an average of $674 each on their hobby. In 1986, 30 million U.S. anglers spent $301 million on licenses; U.S. hunters spent $322 million, and according to the California Office of Economic Research, campers spent more than $2 billion in California in 1990. This spending especially benefits rural areas.

M and M Hunting Lodge on the eastern shore of Delaware provides goose, dove, and duck hunting on what used to be a dairy farm. The owners eventually rented additional farmland for the hunting and developed a conference center on site for get-away workshops. They provide a guide service and other amenities to make an outdoor weekend more comfortable. Fee hunting and overnight accommodations have replaced milk as the primary income source on these farms.

The rough uplands of Illinois farms near the Mississippi River provide cover for deer and game birds valued highly by nearby urbanites. The same management and marketing skills necessary for growing and selling grain can be applied to the deer and other wildlife on the farm (Miller 1999). Hunters will pay as much as $600/acre for access to prime deer territory during hunting season. Leased hunting rights are an alternative, and even hunter outfitters who provide all the necessary equipment can find lucrative opportunities on Illinois farms. Estimates are that 432,000 hunters spend 15 days each in Illinois, a total of 6.4 million hunting days a year providing great economic potential.

Back Roads Adventures attracts urban tourists from Pittsburgh, Cleveland, Philadelphia, Washington, D.C., and other cities to the quiet of Preston County, West Virginia. The company arranges tours for families or individuals through the small towns and farms of the region. It is essentially a tour company, a specialized travel agent for those wishing to experience country landscapes, farm crops, animals, and activities, as well as the crafts, folklore, foods, and inns of backcountry West Virginia. Tour packages range from day to multiple-day trips and are priced accordingly.

The Wal-Mech Farm Bed and Breakfast in Thornville, Ohio, is a working grain and hay farm that has guest rooms for visitors. The owners will help those who want to, to travel in the surrounding area. But they expect most guests to stay on the farm, enjoying the fresh air and general activities. This is primarily a farm with a bed and breakfast opportunity on the side (Mechling 1990).

Graf Growers in northeastern Ohio offers a year-round collage of farm experiences including fee-based seminars in winter months on topics such as container gardening, herb gardening, perennials, and firewood. In October, they charge for hayrides, a cornstalk maze, apple-cider making, and pumpkins supplied to schools. Also, there are Christmas trees and poinsettias as well as a fully stocked farmers' market all summer. All of this is well advertised with a web page and reinforced with brochures and fact sheets (Graf Growers 2001).

Every state seems to have similar opportunities for generating revenue from on-farm recreational activities. The food production part of the operation, the grain, and cover it provides, facilitate the recreational experience. People will pay to visit farms and view areas containing wild and domestic animals in a natural environment such as grain fields, adjacent woodlots, streams, or ponds.

Consumer Horticulture

Gardening is one of the most popular recreational/leisure activities in the United States today. According to a National Gardening Association survey, an estimated 67 million U.S. households spent more than $33 billion on lawn and garden activities in 1999 (Reedy 2001). This was an 11% increase over total dollars spent in 1998. Gardening supplies and services constitute the fifth-largest household cash outlay in 1997 according to the Consumer Expenditure Survey from the Bureau of Labor Statistics (Roper Reports Worldwide 1999). More than 42 million

households list flower gardening as a primary leisure activity (Effortless Gardening 2002). For the past three decades, demand from home-gardeners for unbiased, research-based horticulture information has been increasing continually. To meet this enormous demand, the state of Washington's Cooperative Extension service created the Master Gardeners (MGs) program in 1972. Since its inception, the MGs program has grown from one county to more than 1,000 active training programs in all 50 states and four Canadian provinces. The jointly funded (state, county, and federal) Cooperative Extension MGs program trains volunteer partners who in turn work under extension's auspices to provide horticultural and landscape information and training for urban and rural audiences. The MGs program emphasizes a wide variety of environmental issues such as water conservation and quality, environmental protection, energy conservation, and yard waste management. Other areas of subject matter training include community greening, home and community gardening, youth education through 4-H horticulture, and health and well-being programming for work with elderly and disabled individuals. In Virginia, more than 20,000 people have been trained as Virginia Cooperative Extension Master Gardeners since 1980. From 1995 to 2000, Oklahoma Cooperative Extension specialists have certified 1,200 MGs, who have volunteered for more than 123,000 service hours. In larger states such as Florida, MGs volunteered 730,000 service hours from 1991 to 1996. This was valued as a net in-kind donation of more than $4.6 million (Ruppert, Bradshaw, and Stewart 1997).

The increased demand for gardening, landscape and lawn care information, educational programming, and horticulture plant and hard-good products is expected to continue well into this century (Dickson 2001; Reedy 2001). To meet this continued demand, the television broadcast industry, which often partners with LGU institutions, is focusing on ways to provide gardening and landscape information to the general public. For example, the television show "Oklahoma Gardening" is a joint partnership between Oklahoma State University and the Oklahoma Public Television Network. Initiated in 1975, this show is now broadcast twice/wk, 52 wk/yr and has a weekly audience of 175,000. This is equivalent to 9.1 million people receiving educational gardening and landscaping information annually. Over the past ten years, the "Oklahoma Gardening" audience has grown by 700%. This show supplies consumers with science-based, decision-making information about plant and product selection, appropriate landscape design, wildlife control, and gardening practices. The show also generates revenue for businesses sponsoring the program and/or selling products and services featured on it.

Horticultural Tourism

Plants are an essential part of the urban tourism experience. Flower, vegetable, and tree festivals are held year round to promote tourism and economic development. Many states or regions hold major garden shows or festivals. These activities generate millions of dollars for the local economy. Seattle, Boston, and Philadelphia host some of the nation's largest flower and garden shows. Nearly 40 million U.S. residents, or 20%, went on a garden tour, visited a botanical garden, attended a gardening show or festival, or participated in a garden-related activity in the past five years (TIA 2001). Plants serve many purposes: to make the location more relaxing and soothing and to add color and excitement, among others. In a National Gardening Association survey conducted by the Gallup Organization (Relf, McDaniel, and Butterfield 1992), 50% of respondents indicated that plants and flowers at theme parks, shopping centers, historic sites, golf courses, public gardens, and restaurants contributed to the enjoyment of their visits.

Plants also serve an educational function, as evidenced by botanical gardens and conservatories; ultimately, they are a business investment. To determine the value of interior plants to the hotel/tourism industry, Evans and Malone (1992) conducted a study at Opryland in Nashville, Tennessee. The 12 a. of indoor space has approximately 18,000 plants valued at more than $1 million. The annual horticultural service budget is approximately $1.2 million. The study attributes several positive effects to the "greatscapes," including a high occupancy rate of 85% and numerous national awards. Most important, the higher costs and occupancy rates for those rooms overlooking the gardens generate $7 million in additional annual room revenue.

Touring Green Industry Businesses

Agritourism in the horticulture industry is increasing in popularity. Because the horticulture industry production units often have visual appeal, at least during some portion of the year, considerable opportunity exists to combine a production function with a tourism function (Figure 6.2). The Loudoun County Virginia Economic Development Office organizes three agritourism events annually and produces an attractive brochure and map for each. The Color

Farm Tour lists and describes 17 farms, vineyards, and orchards that welcome visitors during the fall season. A Christmas Loudoun Valley brochure is available, with places for the family to visit and to purchase a Christmas tree or poinsettia. There also is a spring tour during which visitors can experience the planting season. Loudoun County is highlighting its agriculture for city dwellers and bringing economic activity to the rural areas at the same time (Loudoun County 2002)

At least two additional green industry tourism examples are worth noting. The Flower Fields, located just off Interstate 5 in Carlsbad, California (San Diego County, second most populous county in California), is a working farm where *Ranunculus* spp. and

Figure 6.2. Visitors can tour the grounds at Calloway's Stonegate Nursery, a retail garden center in Fort Worth, Texas. Photo courtesy of Tim Davis, Texas Agricultural Experiment Station, Dallas.

other flowers are grown for the commercial production of bulbs and cut flowers (Lobo et al. 1999). During bloom time, lasting about 10 weeks in the spring, more than 200,000 people visit the site and enjoy the striking display of colors, which rivals the tulip fields of Holland (Figure 6.3). An economic study of this operation revealed positive effects for both the farm operations (an additional $600,000 in annual revenue from paid admissions to the fields) and for Carlsbad (total economic effect of $3.8 million/yr).

Another example of agritourism is Ellison's Greenhouses in Brenham, Texas (about 45 miles from Houston city limits) (Bruhn 1999). Six days a week, Ellison's provides guided tours of one of their 100,000-sq-ft production greenhouses. The most popular time for tourists is during the annual poinsettia celebration held before Thanksgiving. An average of about 5,000 persons participate in this event, which results in about $6,000 in profit. In addition to the profits, however, Ellison's uses this opportunity to survey consumers regarding their plant preferences, thus, providing useful marketing information.

Although certainly not applicable to all types of horticultural industry operations, agritourism seems to offer a significant opportunity to maintain production in urban and suburban areas while at the same time taking advantage of valuable, highly visible locations. In each of the three aforementioned examples, consumers are willing to pay admission fees to view horticultural operations, and thereby supplement the value of the commodities produced, while becoming more familiar with the business enterprise. Agritourism also can be used as an opportunity to educate the public about the importance of agriculture to society.

Figure 6.3. The Flower Fields in Carlsbad, California. Photo courtesy of Tim Davis, Texas Agricultural Experiment Station, Dallas.

Public Gardens and Zoos

Botanical gardens, arboreta, zoos, sculpture gardens, and gardens at historical sites and museums represent an important leisure, economic, scientific, and educational asset for urban areas. Botanical gardens have historically had a significant interest in education (and, to a lesser extent, research) for the public good in the areas of landscape design, plant evaluations, environmental conservation, ecology, and wildlife. Most botanical gardens have a variety of seasonal display and theme gardens often designed by professional landscape architects that attract visitors all year round. There are more than 490 institutional members of the American Association of Botanical Gardens and Arboreta. These gardens exist to study, display, and conserve living plant collections for the benefit of the public. Many of these gardens are located in urban areas where they afford urban visitors

an opportunity to become educated about and to experience large-scale horticultural plantings or natural plant ecosystems. These public sanctuaries attract more than 35 million visitors annually. For example, the Chicago Botanic Garden attracts 900,000 people/yr. Assuming that the average visitor spends $10 on parking, refreshments, tours, and other items, this would generate $9 million annually.

Because of botanical gardens, many urban areas actually hold some of the finest collections of plant specimens in the world. More than 1.5 million plant collections for research, education, and conservation purposes are housed in botanical gardens. Many botanical gardens are part of the North American Plant Collections Consortium, an organization whose mission is to collect and to preserve plant specimens and genetic resources. Through their plant collection, conservation, and evaluation efforts, botanical gardens are one of the best sources of plant materials for the commercial horticulture industry and for demonstrating those plants best adapted for use in local gardens and landscapes.

Public gardens often are a gathering place (either due to meeting space or because of staff expertise) for hobbyist collectors and horticulture enthusiasts. Botanical garden staff members are among the most educated horticulturists and botanists in a community. Thus, public gardens become the educational resource for individuals and organized groups who have interest in and enthusiasm for a wide variety of urban agricultural endeavors. Because of their library holdings, many hobbyists frequent public gardens to further their own educations. These enthusiasts may share their expertise with others, free of charge. Botanical garden staff members often become pro bono consultants to city park personnel and urban foresters for plant selection and cultural management.

Public gardens are very involved in outreach activities and educational programs (Figure 6.4). Many gardens focus significant resources on adults and youths who are taught about environmental issues, conservation, wildlife, landscaping and gardening. The public school systems use botanical gardens extensively for educational field trips. Botanical gardens afford urban families the opportunity to learn about nature in an urban setting. Many gardens also offer professional development opportunities for public school teachers.

Many arboreta and botanic gardens have demonstration (enabling) gardens that assist disabled individuals in developing home gardens. A great number of arboreta and botanic gardens are addressing the requirements of the Americans with Disabilities Act by modifying facilities and creating special educational programs of interest to disabled, elderly, disadvantaged, and other special needs populations.

By managing rather large urban land holdings, public gardens are one of the richest sources of biodiversity and open space in urban areas. Many gardens hold collections representative of the diverse ecosystems of their region of state or county. Because of their historical focus on plant selection and conservation, environmental studies, biodiversity, ecology and land use, garden personnel now are active participants in discussions about urban growth and sprawl.

Figure 6.4. A Chicago Botanic Garden staff member joins students at the Von Schiller School to plant a new community garden. Photo by Bill Biderbost, courtesy of the Chicago Botanic Garden, Glencoe, Illinois.

Golf and Other Sports

Sports fields, sports centers, and golf courses are big business. Turfgrass, on which this industry depends, is a product of agricultural science. Most LGUs

employ one or more turfgrass scientists to conduct related research, education, and outreach programs. Professional sports complexes in cooperation with municipalities have established sophisticated growing systems including artificial growing media, drainage, and water-recapture mechanisms that require highly skilled management and operation. For example, specialized turf maintenance equipment and turfgrass varieties have been developed to maintain athletic playing surfaces. Well-managed and maintained golf courses are able to attract revenue-generating professional tournaments that are important to local economies. The city of Tulsa, Oklahoma, for example, estimated that $60 million dollars was brought into the community as a result of hosting the 2001 U.S. Open professional golf tournament.

It is the authors' contention that the demand for recreation and leisure activities will continue to expand over the next several decades. Factors contributing to this expansion will be population increases (especially on a regional basis); greater societal emphasis on health, fitness, and well-being; higher prioritization for leisure and recreational activities by families; and increased discretionary time and income. As discretionary income increases, so does the demand for recreational facilities (Templeton et al. 2000). These factors will result in increased use of environmental horticultural products such as athletic fields, botanical and community gardens, arboreta, parks, and golf courses.

The aforementioned factors in addition to the desire of many urbanites to remain in contact with nature, experience on-farm activities, and have access to hunting grounds and natural landscape settings will afford traditional animal, agronomic, forest, and horticultural production businesses new opportunities for farm diversification and for revenue generation. To attract tourists, farm owners may choose to reprioritize farm operations and expenditures in favor of recreation and leisure activities. As reported earlier in this chapter, traditional farm operations can become a secondary activity or be eliminated completely. Farm owners can become direct competitors with other recreation and leisure businesses. Universities and colleges will be called upon to continue and/or to increase (as demand grows) education, training and other services to support the existing expanding recreation and leisure industries as well emerging recreational and leisure enterprises initiated by traditional farm operations. Finally, expansion of traditional farm operations (animal, agronomic, horticultural, and forestry) to include recreation and leisure activities can serve to educate the consumer about the diversity within the agriculture industry, to foster appreciation and understanding of each other's needs and activities, and to drive development of beneficial recreational partnerships between communities and farms.

7 Policy and Institutional Dimensions of Urban Agriculture

Introduction

Population growth and a taste for fringe or open-country living fuel continual interest in land management policy near cities. The directions and content of this policy agenda differ among nations, but often can be traced to social adjustments occurring in the aftermath of World War II. Still, many observers are impressed by the intensity of the debate during the past decade. Dialogue over smart growth, sprawl, and related land-use issues seems to be sweeping the United States. Studies have proliferated and media attention has increased. According to a recent U.S. survey (Pew Center 2000), nearly one-fifth of respondents listed sprawl-related issues (e.g., development, traffic, roads) as "the most important problem facing the community where you live." This issue was highlighted most often by suburban, college-educated, white residents of the United States.

The Pew Center (2000) reported that 88% of U.S. workers commute to their jobs each day, with only 5% indicating that they take public transportation to work. The average commute is increasing and, not surprisingly, the longer the commute, the more likely a respondent is to say that traffic congestion and other sprawl-related issues are a major problem. Fifty-one percent of those living in big cities say traffic congestion is a major problem, and 46% of suburbanites agree. Only 18% of those living in rural areas indicate that traffic is a major problem.

Forty-one percent of those living in the suburbs consider too much growth and development as a major problem, compared with only 31% of those living in big cities and only 21% in rural areas. Those who have attended college are more likely to see sprawl as a major problem than those who have not (32% vs. 24%, respectively). African-Americans are less likely to see growth and development as a problem (56% stated it is not a problem) compared with whites (42%) and Hispanics (33%) (Pew Center 2000).

Population growth is not the sole factor fueling sprawl. For example, from 1970 to 1990, the population of Los Angeles (California) grew 45% while developed land grew 200%; Cleveland's (Ohio) population dropped 11% while consuming 33% more land; Chicago's (Illinois) population increased 4% while developing 46% more land. These trends continued in the 2000 census, suggesting that sprawl tends to follow highway construction (Freedgood, J. 2002. Personal communication). According to the USDA's NRI, between 1982 and 1992, 29% of agricultural land converted to urban use was prime agricultural land (USDA-NRCS 2000c). Prime and unique[10] farmland made up 22% of 127 threatened major land resource areas (MLRAs) identified by the American Farmland Trust (AFT), and 32% of this resource was consumed by urban development.

Interest in growth management stems from numerous considerations. The 2000 Census indicates that the U.S. population grew by 13.1% during the 1990s. Aggregate growth rates, however, mask the dramatically higher growth in many sections of the country, particularly in the Sunbelt, the Intermountain West, and the Far West. During the last decade, the national economy has experienced a period of unprecedented growth and wealth creation. Needs for developed residential, commercial, industrial, and transport uses have increased concomitantly. On open-space lands in proximity to larger urban cores, low-density development causes MAs to sprawl further into the countryside and increases the density of settlement in these formerly rural areas. The extent of urbanized areas and urban places, as defined by the Bureau of the Census, more than doubled over the last 40 years from 25.5 million a. in 1960 to 55.9 million a. in 1990; urban area may be in the range of 65 million a. when the 2000 decennial census is reported. The continuation of this level of growth could put substantial pressure on the continuing availability of quality farmland, the nation's ability to achieve a reasonable level of food self-sufficiency, and the availability of water and energy resources to support a shift in location to new or less productive lands.

The recently completed 1997 *National Resources Inventory* (NRI), using a more expansive definition of

[10]Unique farmland acreage was estimated by using fruit and vegetable crops.

land used for urban and built-up purposes, indicated that land conversion accelerated dramatically in the early 1990s (USDA-NRCS 2000b, Table 8). Between 1982 and 1997, the annual conversion rate was 1.2 million a./yr. During the period from 1992 to 1997, however, the conversion rate had increased to 2.2 million a./yr. Urban and built-up areas counted in the NRI included those measured by the Census Bureau, including developed areas as small as 10 a. outside urban areas. The addition of roads and other transportation methods expands the total further. The NRI-developed area increased from 73.2 million a. in 1982, to 87 million a. in 1992, and to 98.2 million a. in 1997.

The U.S. farm, food, and agricultural industries are at the epicenter of the ongoing debate over growth management in the urban periphery. The evidence, and indeed the day-to-day driving experience of many U.S. residents, clearly shows that considerable amounts of acreage now devoted to farming and food production are directly in the path of land conversion. Is production capacity jeopardized by these land conversions? Just how can agriculture and plant industry businesses (e.g., horticulture, forestry) adapt to sprawl? What changes in products and services will be needed to allow farmers to capitalize on the opportunities afforded by close proximity to urban markets? Do rising land values and increasing contact with new residents, who, more often than not, are uninformed about modern farming practices, doom the vibrancy of farming communities? Or will farmers and plant industry firms be able to reinvent their businesses to emphasize higher-value products, more intensive production with environmentally friendly practices, and more urban-oriented marketing and distribution strategies? Another key issue associated with land conversion pertains to the efforts that industry makes to build good neighborhood relationships.

The section that follows pays close attention to the roles of local, state, and federal governments in growth management, open-space, and farmland protection policies. Tools and techniques are considered that combine both regulation and incentive-based strategies, that are used to protect farmland, and that support agriculture's economic viability. As has been stated, land use in the rural-urban confluence, where the results of haphazard development often are clearly visible, is frequently one of the most hotly debated issues at local and state levels. Even in rural areas, especially where there are scenic amenities or areas are within commuting distance from employment centers, land management often is a divisive topic. When greater emphasis is given to development of the fringe area, older suburbs and inner cities may be neglected. When planners focus on one of these sectors to the exclusion of others, outcomes often are costly and the interests of certain groups may be favored over those of others. Public perspectives on land use clearly are tied to deeply held values about individual rights, land, and automobiles. Without broad public and private sector involvement in the process, and public education on the costs and benefits of proposed strategies, it may be difficult to generate support for much-needed land-use control measures. One of the keys for the future will be to find ways in which different jurisdictions can identify commonalities and cooperate on a regional basis to address the overall needs of the rural-urban agroecosystem.

Setting Policy

To a great extent, the answer to the aforementioned questions will depend on policies that meld modern agriculture—including horticulture and forestry—with the emergent urban scene. These policy interventions, in turn, must be calibrated to legal, social, political, and cultural parameters constituting the "rules of the game," which must be established and revisited continually by U.S. citizens and their governments. The texture of the debate can and indeed does differ from region to region of the nation. In the arid western United States, much acreage remains in the public domain, and managing land use near urban areas is connected to decisions on the use of public land. Otherwise, decisions on the use of U.S. farmland reside very firmly in the hands of individual and corporate owners. Privately owned land trades freely in real estate sale and rental markets and is passed between and within generations through gifts and inheritances. Such trades and transfers are relied on heavily to ration the finite supply of agricultural land among alternative uses.

Public authority to intervene in land markets and decisions regarding private use and ownership of land reside largely with state and local units of government. Such authorities are threefold. First, local governments are empowered to levy an annual property tax on real estate. Property taxes, a principal source of revenue for units of local government, increase the economic costs of owning real estate; subsequently, because asset values fluctuate over time, land values change. Second, the U.S. constitution delegates direct powers to regulate land use, commonly referred to as the "police powers," (zoning) to state governments. The states, in turn, often delegate further much of the police power to lower units of gov-

ernment such as counties, cities, villages, townships, and a plethora of special districts. Finally, U.S. land policy is shaped by a constitutional guarantee against the taking of private property without just compensation. This guarantee applies to direct land acquisitions through powers of eminent domain or condemnation. Additionally, case law has extended this constitutional protection to other "takings" that can result from overzealous efforts by governments to regulate private landowners and the decisions they make regarding the use of their land.

"Farmland lies in the middle of the spectrum of private and common interests in land" (Donahue 1999, 288). The common interest in agricultural land is not well served by most private landowners, including farmers and ranchers. The current economic environment does little to foster the continuation of small farms, to promote sustainable agricultural practices, or to discourage the sale of productive land for environmentally appropriate development. Donahue (1999) anticipates that this situation is not going to go away. The question is how can we best protect our highest quality resources? In the best interest of total society, we must prevent our best soils from being lost. Both rural and urban people must join together in determining the best possible use of land, including farmland, to meet their common interests. These interests might include an integrated balance of more sustainable, yet productive, uses of land for such activities as food and fiber production, open space for environmental services, recreation, and economic development.

Within this institutional framework, public policies on agricultural lands have evolved over the past four decades under the rubric of "farmland protection." A blend of regulatory and incentive programs exists. Primary emphasis has been placed on incentive approaches designed to promote agriculture by affording property owners relief from legal conflicts with adjacent property owners, reducing property taxes, or providing compensation to farmland owners who participate in programs restricting the conversion of their lands from future development.

Farmland protection programs have not been ignored at the federal level. The U.S. Congress considered, but rejected, a number of legislative initiatives in the 1970s. These proposals would have given the central government a very noticeable and direct stance in land-use planning and would have provided the "deep pocket" for capitalizing farmland protection efforts at state and local levels. Congress did not act during those years, in part because of a prevailing view that conversion of farmland to urban use did not pose an immediate or even a longer-term threat to the nation's capacity to meet expected food and fiber needs.

New research conducted in the 1970s and 1980s demonstrated, however, that considerable farm production is in close proximity to urban population concentrations. Conversions to urban use were shown to be, to some extent, offset by added cropland acreage in the aftermath of drainage improvements on wetlands, deforestation, and tillage for crop rotations on former pasture and grazing lands. Much pasture and grazing land conversion, particularly in the arid western United States, has been induced by availability of supplemental irrigation water from groundwater aquifers or from publicly financed surface water impoundments. According to CAST (1996), approximately 75 million a. of cropland are irrigated in the western United States. In 1990, irrigated agriculture accounted for nearly 85% of developed water supply used in the West. Population growth in the western states has accelerated, with most growth occurring in urban areas. This growth has led to increased demand for water for municipal and industrial uses. The competition for available supply has intensified. Because western state legislative bodies have been dominated primarily by urban interests, a balance between agricultural and nonagricultural interests has been lacking. This scenario underscores the importance of rural-urban collaboration to address ways in which limited natural resources such as water can be shared equitably and protected for future generations.

Despite the concern of some people during the last quarter-century, it still seems that the nation's domestic food and fiber needs are assured. Less than 50% of U.S. cropland is presently used to meet domestic food and fiber requirements. The remainder is available to service export markets. Congress is continually coping with excess food and fiber production capacity. Nearly 35 million a. are idled under federal subsidy programs through enrollments in the conservation reserve program (CRP) (Chadbourne and Chadbourne 2000). Based on 1997 USDA figures, there were 455 million a. of cropland in the United States. Between 7 and 8% of total U.S. cropland is idled under the CRP program (Vesterby and Krupa 2001).

Land Protection Initiatives

For the reasons stated in the previous section, direct engagement of the U.S. Congress in farmland protection programs has come about in an evolutionary

process. After an exhaustive but inconclusive federal assessment of the farmland protection issue in the late 1970s (National Agricultural Lands Study 1981), Congress passed the Farmland Protection Policy Act in 1981. The USDA did not implement this act for many years and the legislation stopped short of providing financial assistance to state or local governments for farmland protection programs. The act did require federal agencies to identify any adverse effects their programs might have on farmland protection and minimize the extent to which such programs induce unnecessary farmland conversions. This legislation can help ward off the most obvious conflicts between federal and state policies, but the direct effect of this legislation on land use and conversion of land to urban use probably has been minimal. Such effects are more likely to evolve out of direct U.S. Treasury expenditures to support state and local farmland protection efforts.

In the 1990s, movement in the direction of farmland protection appeared, signaling a shift in federal policy. As part of the 1990 omnibus farm legislation, Congress passed the Farms for the Future Act, which authorized the USDA to provide federal loan guarantees and interest rate subsidies to state governments providing matching monies to operate farmland protection funds. Little was done to implement these authorities, but the legislation did set the stage for more focused Congressional action under the 1996 Farm Bill, which established the Farmland Protection Program (FPP). Funds for the FPP come from the federal government's Commodity Credit Corporation (CCC), which funds several USDA conservation and environmental programs. Total funding authorized for the program was $35 million (Chadbourne and Chadbourne 2000), a sum quickly expended by the USDA.

Recent (1999) legislative proposals requested a reauthorization of the FPP at $55 million/yr through 2002, but the 106th Congress did not act. However, the Agricultural Risk Protection Act of 2000 provided $17.5 million in financial and technical assistance for the purposes described by the FPP in fiscal year 2001. Interestingly, the Natural Resources Conservation Service (NRCS) has indicated that $10 million of $17.5 million available in matching grants for purchase of conservation easements on agricultural lands was open to applications from private nonprofit organizations such as land trusts (Lawrence, R. D. 2002. Personal communication).

Purchase of development rights (PDR) programs alone will not resolve problems associated with farmland loss for the following reasons:

- PDR programs are not keeping up with farmers' needs for timely compensation;
- most funding is subject to bonds, appropriations, and special taxes, so that farmers cannot necessarily count on it for future transactions; and
- funds do not necessarily flow to farmers in areas where development threatens agriculture.

Although the federal government has done more than most states to promote conservation, funds for PDR are still very inadequate. Average per capita expenditure on easements in states with programs is only $0.60 (Thompson and Warman 2000).

Daniels (1999) contends, by contrast, that because most state and farmland preservation programs originate in urban-fringe areas, most federal funds are being directed to those areas. Although farmland protection efforts are aimed at preserving open-space and farmland through the purchase of conservation easements, there is considerable debate as to whether they are successful at maintaining agriculture as a profitable business.

Conservation easements complement longer-lived provisions in the federal income tax code that provide indirect financial incentives and that are legal instruments restricting the use of land to specified conservation purposes while precluding future conversion to a developed use. These incentives are targeted at individual landowners who participate in private farmland protection programs operated by nonprofit organizations. Specifically, the federal tax law enables taxpayers to claim deductions for charitable contributions of conservation easements to qualifying private land trusts and organizations. Some landowners can benefit by such contributions because the resultant tax deduction can decrease income tax liabilities on income earned from other sources.

The Farmland Protection Toolbox

Regulatory Programs

In the United States, efforts to regulate the use of farmland are manifested primarily in the implementation of zoning laws. Zoning uses police power to control land use. A zoning law—typically called a *zoning ordinance* in the United States—divides the land area of a jurisdiction into various districts so that land is used for consistent, compatible purposes. Zoning ordinances usually define allowable property uses, prescribe usage intensities (e.g., number of residential building lots/land parcel), and specify the rules

to be followed when a structure is placed on the site. Zoning first was applied in urban settings, but important examples of rural zoning date to the 1930s in a few regions of the United States. Increasing applications of zoning are found on the urban fringe, or in metropolitan counties where land development for urban-related purposes and commercial agriculture can come into close contact (Textbox 7.1).

Zoning ordinances are promulgated by some very local levels of government that tailor their regulatory efforts to local conditions. Zoning laws often are combined with additional rules and regulations regarding subdivisions of land parcels into smaller ownership units. Many localities have zoning laws oriented almost exclusively to controlling the development of residential and commercial properties. These jurisdictions may contain substantial quantities of farmland, but often their zoning laws make no explicit provisions for protecting agricultural land from urban encroachment or for converting land, in an orderly fashion, to future development use. Weak or ineffective regulation of this sort often is supported by developers and landowners who want eventually to sell their agricultural land, or to develop it with minimal interference from local governments.

According to the AFT, agricultural protection zoning ordinances take many forms. The AFT categorizes these ordinances as *exclusive agricultural zoning*; *large minimum lot size zoning*; *area-based allowance zoning; fixed area-based allowance zoning*; and *sliding scale area-based allowance zoning.* The AFT identifies agricultural protection zoning statutes in only 14 states; the most restrictive exclusive agricultural zoning statutes are found in Oregon and Wisconsin—two states with an exceptionally long history of involvement in zoning initiatives (AFT 2002c).

Rural communities in most states have the option of undertaking either nonexclusive or exclusive agricultural zoning. A *nonexclusive ordinance* is designed to include nonfarm development in the farming zone even though farming is the preferred or priority use. An ordinance requiring homeowners to build on a large land parcel—called *large lot zoning*—is a common form of nonexclusive agricultural zoning. Large lots limit the number of nonfarm buildings in the agricultural zone. Under *exclusive agricultural zoning*, nonfarm dwellings and buildings are prohibited strictly from the agricultural zone. Large lot development, even with an agricultural purpose, does not generally do much to protect agriculture and is an expensive community development pattern. Government review of a plan to build a farm dwelling in the agricultural zone also can be required. This type of ordinance severely restricts land management options and sometimes proves very unpopular with owners of open, developable land. Governments with such ordinances can be vulnerable to legal proceedings whereby owners seek compensation for a "taking" of their constitutionally guaranteed property rights. Because of political and legal pitfalls, few governments pursue exclusive agricultural zoning at the local level.

Incentive Programs

There are a number of political realities confronting U.S. public policy on farmland protection. Using only police power (zoning) has had limited success in protecting and regulating farmland use. The best strategy for farmland protection requires the combined use of federal, state, and local preservation measures (Lapping and Pfeffer 2000).

Farmland owners, especially active farmers and ranchers, typically voice support for farmland protection objectives but generally endorse programs that are voluntary and provide financial incentives for participants. Consequently, the bulk of state/local farmland protection programs have stressed these two features in program design.

Agricultural Districts

Agricultural districts are legally recognized geographic entities in which farming is recognized as a priority land use. Sixteen states have passed legislation enabling the creation of agricultural districts, according to the AFT (2001a). Districts are created for fixed but renewable periods of time and feature a series of pro-farming provisions that attempt to improve conditions for the continuation of farming within the district's boundaries. Pro-farming provisions differ, but can include decreased property taxes (as part of the use-value assessment program already discussed), state policies to encourage farming, and modification or limitation of practices thought to hinder it. These latter policies include local laws that are unduly restrictive on normal farming practices, use of condemnation proceedings (eminent domain) on actively farmed land, and restrictions on publicly funded investments promoting nonfarm development in an agricultural district (Textbox 7.1)

Agricultural district programs often are popular with farmers because participation is voluntary for each landowner. In exchange for enrollment, farmers receive a package of benefits, variable by state, for keeping their land in agriculture. Similarly, local gov-

Textbox 7.1. Primary public farmland protection tools: Benefits and drawbacks (American Farmland Trust 2002)

Agricultural Protection Zoning

Zoning is a form of local land use regulation. Agricultural protection zoning (APZ) ordinances protect the agricultural land base by limiting non-farm uses, prohibiting high-density development, requiring houses to be built on small lots and restricting subdivision of land into parcels that are too small to farm.

Benefits

- APZ is an inexpensive way to protect large areas of agricultural land.
- By separating farms from non-agricultural land uses, APZ reduces the likelihood of conflicts between farmers and non-farming neighbors.
- APZ helps prevent suburban sprawl and reduces infrastructure costs.
- Compared to purchase of conservation easement and transfer of development rights programs, APZ can be implemented relatively quickly.
- APZ is easy to explain to the public because most landowners are familiar with zoning.
- APZ is flexible. If economic conditions change, the zoning can be modified as necessary.

Drawbacks

- Zoning is not permanent. Changes in APZ ordinances can open up large areas of agricultural land for development.
- APZ can reduce land values, which decreases farmers' equity in land. For this reason, farmers sometimes oppose APZ, making it difficult to enact.
- APZ may be difficult to monitor and enforce on a day-to-day basis.
- County APZ ordinances do not protect agricultural land against annexation by municipalities.

Agricultural Districts

Agricultural districts are legally recognized geographic areas designed to keep land in agriculture. Formed by one or more landowners and approved by one or more government agencies, they are created for fixed, renewable terms. Enrollment is voluntary; landowners receive a variety of incentives that may include eligibility for differential assessment, limits on annexation and eminent domain, protection against unreasonable government regulation and private nuisance lawsuits, and eligibility for purchase of agricultural conservation easement (PACE) programs.

Benefits

- Enrollment in agricultural districts is voluntary, making the programs popular with farmers.
- Agricultural district programs are very flexible; benefits and restrictions can be tailored to meet local objectives.
- Agricultural districts provide multiple benefits to farmers, including tax relief, protection from local regulation and eligibility for PACE programs.
- Agricultural districts help secure a critical mass of land to keep farming viable.

Drawbacks

- Sanctions for withdrawing land from agricultural districts may not be strong enough to discourage conversion.
- Limits on non-farm development may not prevent expansion of public services such as water and sewer lines into agricultural areas. Some agricultural district laws address this issue; others do not.
- In some states, the benefits provided by agricultural districts are not enough incentive for farmers to enroll.
- In some states, the procedure for creating agricultural districts is lengthy and complex.

ernments often are receptive to the prospect of creating agricultural districts, because the district program may be relatively easy to administer and, to date, is not subject to legal or constitutional challenges. Finally, districts usually do not provide substantial outlays of public funds. Agriculture district programs should not be confused with zoning programs that delineate areas governed by local land use regulations.

Agricultural Tax Programs

Initial efforts to alter state farmland policy focused on the local property tax, which is one of the largest revenue sources for local governments. Tax levies increased abruptly after World War II, particularly on the urban fringe where population growth generated increased public service needs. Higher property tax levies on farm real estate are criticized on both tax equity and land-use grounds. Objections on equity grounds can be traced to farmers' concerns that they will be unable to pay the tax or that they will be taxed out of proportion to the benefits received from services funded by the tax. Land-use concerns flow from the argument that high property taxes induce conversion of farmland to urban uses or decrease the net returns from farming sufficiently to force termination of farming operations before land is really needed for a developed use.

Textbox 7.1. (continued) Primary public farmland protection tools: Benefits and drawbacks (American Farmland Trust 2002)

Agricultural Property Tax Relief

There are two types of agricultural tax relief programs. Differential assessment laws direct local governments to assess agricultural land at its value for agriculture, instead of its full fair market value, which is generally higher. Differential assessment laws are enacted by states and implemented at the local level. With a few exceptions, the cost of the programs is borne at the local level. Circuit breaker tax programs offer tax credits to offset farmers' property tax bills. Like differential assessment laws, circuit breaker tax relief credits reduce the amount farmers are required to pay in taxes. The key difference is that most circuit breaker programs are based on farmer income and are funded by state governments.

Benefits

- Agricultural tax programs help farmers stay in business by lowering their expenses.
- Agricultural tax programs help correct inequities in the tax system.

Drawbacks

- Agricultural tax programs do not ensure long-term protection of farmland.
- Differential assessment programs often provide a subsidy to real estate speculators, who are keeping their land in agriculture pending development.

Purchase of Agricultural Conservation Easements

Purchase of Agricultural Conservation Easements (PACE) programs pay farmers to keep their land available for agriculture. Landowners sell an agricultural conservation easement to a qualified public agency or private conservation organization. Landowners retain full ownership and use of their land for agricultural purposes. PACE programs do not give government agencies the right to develop land. Development rights are extinguished in exchange for compensation. PACE also is known as purchase of development rights (PDR) among other names.

Benefits

- PACE protects farmland permanently, while keeping it in private ownership.
- Participation in PACE programs is voluntary. PACE can be implemented by state or local governments, or by private organizations.
- PACE provides farmers with a financially competitive alternative to development, giving them cash to help address the economic challenges of farming in urban-influenced areas.
- PACE programs can protect ecological as well as agricultural resources.
- PACE limits the value of agricultural land, which helps to keep it affordable to farmers.
- PACE programs involve the non-farming public in farmland protection.

Drawbacks

- PACE is expensive.
- PACE can rarely protect enough land to eliminate development pressure on unrestricted farms.
- PACE programs are generally unable to keep up with farmer demand to sell easements. This results in long waiting lists and missed opportunities to protect land.
- Purchasing easements is time-consuming.
- The voluntary nature of PACE programs means that some important agricultural lands are not protected.
- Monitoring and enforcing easements requires an ongoing investment of time and resources.

Beginning with the State of Maryland in 1956, all state legislatures have made arrangements to grant farmland owners relief from local property taxes. Now all 50 states offer some form of tax relief for agricultural land; however, only 24 have enacted agricultural protection zoning (APZ) ordinances. These ordinances protect the agricultural land base by limiting nonfarm uses, prohibiting high-density development, requiring houses to be built on small lots, and restricting subdivision of land into small parcels (Textbox 7.1). Although administrative arrangements vary widely from state to state, these programs, for the most part, focus on limiting annual tax levies on land value in agricultural use. This practice can result in lower taxes because a levy based on the full market value standard can be circumvented. Differences between market, or full, value and agricultural value can be especially noticeable in the development of urban areas where value of open land begins to reflect the higher income expected from future conversion to a developed use.

Four states have enacted additional tax credit programs in the form of circuit breaker tax relief. Circuit breaker tax relief credits reduce the amount farmers and ranchers are required to pay in taxes. The program, funded by state governments, is primarily

Textbox 7.1. (continued) Primary public farmland protection tools: Benefits and drawbacks (American Farmland Trust 2002)

Right-To-Farm Laws

Right-to-farm laws protect farmers and farm operations from public and private nuisance lawsuits. A private nuisance interferes with an individual's use and enjoyment of his or her property. Public nuisances involve actions that injure the public at large.

Benefits

- Right-to-farm laws strengthen the legal position of farmers and act as a deterrent to public or private nuisance complaints.
- Right-to-farm laws protect farmers from unreasonable local controls on standard agricultural operations.
- Right-to-farm laws provide farm families with a psychological sense of security that farming is a valued and accepted activity in their communities.
- Right-to-farm laws sometimes allow farmers to recoup legal costs from frivolous law suits.

Drawbacks

- Right-to-farm laws do not prevent nuisance complaints.
- Right-to-farm laws may interfere with neighbor's property rights to such an extent that it is deemed to be an unconstitutional taking of private property rights without just compensation.
- Right-to-farm laws have rarely been interpreted by the courts.
- Right-to-farm laws do not prevent farmland from being converted to other uses.

Transfer of Development Rights

Transfer of Development Rights (TDR) is a program that allows landowners to transfer the right to develop one parcel of land to a different parcel of land to prevent farmland conversion. TDR programs establish "sending areas" where land is to be protected by agricultural conservation easements and "receiving areas" where land may be developed at a higher density than would otherwise be allowed by local zoning. Landowners in the sending area sell development rights to landowners in the receiving area, generally through the private market.

Benefits

- TDR protects farmland permanently, while keeping it in private ownership.
- Participation in TDR programs is voluntary—landowners are never required to sell their development rights.
- TDR promotes orderly growth by concentrating development in areas with adequate public services.
- TDR programs allow landowners in agricultural protection zones to retain their equity without developing their land.
- TDR programs are market-driven—private parties pay to protect farmland, and more land is protected when development pressure is high.
- TDR programs can accomplish multiple goals, including farmland protection, protection of environmentally sensitive areas, the development of compact urban areas, the promotion of downtown commercial growth and the preservation of historic landmarks.

Drawbacks

- TDR programs are technically complicated and require a significant investment of time and staff resources to implement.
- TDR is an unfamiliar concept. A lengthy and extensive public education campaign is generally required to explain TDR to citizens.
- The pace of transactions depends on the private market for development rights. If the real estate market is depressed, few rights will be sold and little land will be protected.

based on farmer/rancher income in which some form of tax credit is given to offset property tax bills (American Farmland Trust 1999).

Purchase of Development Rights (or Conservation Easements)

Probably the most popular land protection tool today involves efforts to separate the right to develop land from the landowner and subsequently to transfer it to public or third-party ownership. Such policy initiatives explicitly recognize the conflicts generated for active farmers who wish to conduct a farm business but also to protect their financial interests in farmland value appreciation. These conflicts are particularly intense in farm communities experiencing pressure to convert land to urban-related uses. Such pressures are manifested in wide differences between market value of land and its value in a farm use.

A farmland development right reflects those differences in land values and refers to the landowner's right to construct nonagricultural structures on the land. Traditionally, this right has been thought of as one of a bundle of rights making up the benefits of land ownership. Development rights programs acquire this right from the landowner so that use of the land can be restricted legally into the future. This re-

striction takes the form of an easement and is recorded with the property deed (Textbox 7.1)

Under a Purchase of Development Rights (PDR) program (sometimes called Purchase of Agricultural Conservation Easements), use of land is restricted with an agricultural conservation easement. In compensation for restricting use of the land, the owner receives a sum of money typically equal to the value of the foregone development potential. Easement values also may be determined by a numerical scoring system (points) that evaluates the land's agriculture production potential. This value typically is calculated as the fair market value of the land minus its agricultural value. These values are determined by standard real estate appraisal methods.

Prospects for tailoring easements to farmland protection objectives were discussed initially in New York in the early 1960s, when the state legislature passed enabling legislation permitting local governments to acquire land rights for the purpose of preserving open space. Suffolk County, located on the densely populated Long Island Sound in New York State, subsequently pioneered the first nationally recognized PDR program, which was enacted in 1974. King County, Washington, containing the city of Seattle, soon followed with PDR acquisitions in 1979. Twenty-two states have state or locally funded PDR programs (Freedgood, J. 2002. Personal communication). State boards or commissions are appointed to devise procedures for reviewing applications made by owners wishing to sell development rights. In some instances, local committees or land preservation boards are established to assist with administration of the program and with selection of land parcels for development right acquisition.

Purchase of Development Rights programs are voluntary, and state or local governments initiating them usually have more applications for easement sale than can be accomplished with available funds. Funding is crucial because easement purchase can be enormously expensive when a land parcel is prone to development. One of the biggest challenges for governments is to find ways to pay for purchase of conservation easements. Potential funding sources include bonds, taxes (property, sales, real estate transfer), annual appropriations, and federal dollars (transportation funding, Farmland Protection Program), and other creative sources. Several state-operated programs make explicit provisions for private contributions from third parties—individual residents, corporations, or private organizations—wishing to assist farmland protection efforts.

Right-to-Farm Laws

Right-to-farm laws attempt to give farmers a measure of protection from private nuisance suits by modifying common nuisance law. A private nuisance interferes with an individual's use and enjoyment of his or her property (Textbox 7.1).

Urban-related growth and development in traditional farming communities can generate complaints from new nonfarm residents about farming practices. Common concerns have to do with dust, odor, noise, vibration, and use of agricultural chemicals. In some instances, offended neighbors resort to legal actions to seek relief in the form of court suits waged against farm neighbors (Daniels 1999).

To assist farm operators who may need to ward off such legal actions, legislatures in all 50 states have enacted right-to-farm laws. These laws have little clout in the courts; this may change, however, as more people move to the urban fringe and file suits based on trespass rather than nuisance doctrine. Consequently, a plaintiff could claim that noise, dust, or odor are leaving the farm, thus affecting nonfarm property and decreasing the neighbor's enjoyment of his or her property. Nuisance suits against a farmer may have little chance of winning, but cost and aggravation to the farmer may be significant. In some states, the farmer is not protected from nuisance suits, e.g., if he or she changes the operation from a dairy farm to a hog farm (Daniels 1999). Proponents of such laws argue that by eliminating, or at least decreasing, the threat of future lawsuits over standing-farming activities, the chilling effect of legal action is restricted greatly and farm operators subsequently will make new investments and take other steps needed to promote the viability of their farm businesses.

Regardless of right-to-farm laws, when farmers or ranchers see nearby land being developed, they tend to decrease their level of investment in their own farm in anticipation of selling the land for development. This process called *impermanence syndrome* describes a process of disinvestments in farming or a reduction of the intensity of farm production in anticipation of future land use conversion (Berry 1978; Heimlich and Anderson 1987).

Transfer of Development Rights

Transfer of Development Rights (TDRs) enable the landowner to transfer the right of development from one parcel of land to another. The TDR programs, often established by local zoning ordinances to protect farmland, can shift development from agricultural use areas to designated growth zones that are closer to municipal services. These programs allow land-

owners to separate and sell the development rights from their other property rights (Textbox 7.1). Transfer of Development Rights can be designed to address multiple goals including agricultural land protection, conservation of environmentally sensitive areas, and preservation of historically significant lands. Although this mechanism prevents nonagricultural development of agricultural land, it also reduces the market value of the protected land while providing the owner with liquid capital. The TDR programs can be distinguished from PDR programs by their association with the private market. Most TDR transactions are between private landowners and developers.

The TDRs may be more appropriate to urban areas where the market is more conducive to transfer of development rights, thus avoiding problems of confiscation and the fact that PDRs are so expensive (Lapping, M. 2000. Personal communication).

Private Land Trusts

Direct third party efforts to protect U.S. farmland are emerging through a proliferation of private, not-for-profit land trust and conservancy organizations. Private land trusts and conservancies dedicated to natural resource conservation have been in existence for more than a century, but their numbers multiplied rapidly in the 1980s and 1990s. These nonprofit organizations usually are registered with the U.S. Internal Revenue Service, and individuals or corporations donating funds or property to support their programs may be in a position to treat donations as a charitable contribution when filing income tax returns. Charitable contributions are tax deductible, thereby decreasing the donor's taxable income. Income tax reform in the mid-1980s, combined with elevated public concern about rural resource conservation, helped stimulate interest in private land trusts at both national and regional levels.

These third-party organizations are increasingly active in the farmland protection arena. They often have broad conservation objectives and focus on a variety of natural resources in a designated region. A 1992 study reported that more than 30% of local and regional organizations in the Northeastern United States protected some agricultural land (Weir and Bills 1992). Although conservation easement donations are frequently used, other methods include educational and consulting services for landowners.

8 New Visions for Urban Agriculture

Introduction

This report has discussed agriculture in a new light. Agriculture's contemporary role in an urbanizing society has been the central theme. When viewed broadly, agriculture can serve as a valuable resource for both rural and urban leaders concerned about issues of community economic development, land use conservation and management, and community livability. The term *urban agriculture* refers to a complex system encompassing a full spectrum of activities from a traditional core of production, processing, marketing, distribution and consumption, to more extensive system components including recreation and leisure, business entrepreneurship, individual health benefits, scenic beautification, environmental restoration and remediation, community health and well-being services, and economic vitality. The report identifies partnership opportunities and policy recommendations for urban and rural leaders and decision makers to enable more cooperative solutions to common and complex environmental, health, safety, nutritional, social, and economic problems. It recommends changes that the agriculture system, universities and colleges, and various levels of government must undertake to remain relevant to society.

An interdependency exists between rural and urban areas, which is illustrated aptly by the concept of a rural-urban agroecosystem within which agriculture plays a major contributory role. The *rural-urban agroecosystem* is defined as a biological and natural resource system that must be managed jointly by rural and urban people for the purposes of

- producing safe and accessible food and nonfood products,
- providing services to the environment and community,
- generating direct and indirect social and economic benefits to the rural-urban system, and
- ensuring individual and community health and well-being.

Only in cooperation with other partners can agriculture help resolve the challenges facing a rapidly urbanizing society. Many problems facing the rural and urban subsectors of U.S. society have similar effects (Figure 8.1). Although the sources of problems may differ, their effects on the environment, the community, and the individual are very similar. Successful response and cost-effective resource use will require joint planning, problem solving, and cost sharing. Each partner can bring unique knowledge and experience to the situation and, simultaneously, can derive mutual benefits from the working relationship.

The last decade has brought about sweeping changes in the public's interest in food systems, diet and health, information access, natural landscapes, and environmental protection and conservation. This period also has witnessed a decline in the profitability of farms and ranches and in the numbers of people directly involved in farming and ranching, as well as in the loss of productive farmland. These changes have been accompanied by intense debate among stakeholders concerning which policies are needed, what the impacts of policy and funding decisions will be, who will be affected by these decisions, and who will pay for the proposed solutions. With increased population densities and commuting times, people seek additional meaning in their lives, an enhanced sense of community, and more opportunities to reconnect with nature. Many of these expectations are occurring, however, as natural resources (e.g., land, water, and air) are diminishing in quality and/or quantity.

Economic growth and improvements alone cannot sustain communities. Community prosperity also necessitates investment in human and social capital, for example, in new sources of innovation and entrepreneurship. This may mean enticing immigrants to relocate to communities lacking sufficient human resources. The survival of rural communities depends on the development of strategies for such communities to connect to each other and to find ways to link to thriving metropolitan centers (Stauber 2001). Comprehensive planning for sustainability should address

Problems in the Rural Agricultural Subsystem	Potential Impacts	Problems in the Urban Agricultural Subsystem
Animal Waste Disposal • From animal/poultry feedlots (confinement operations) that generate waste	Contamination (air, soil, water), psychological stress (animals), health problems (animal, humans), increased management costs, disposal problems	Human/Animal Waste Disposal • From residential "feedlots" (city and suburban residences), companion animals, and urban wildlife, all of which generate waste
Food Processing Waste Disposal • Plant parts and waste water disposal that generate waste	Contamination of air and water resources, water treatment problems, sewer system capacity limitations, potential threat to human health	Household Waste Disposal • Plant parts and waste water disposal
Pesticide and Fertilizer Applications • For commercial crop production • For highway and utility right-of-ways, vegetation control programs • For insect control in food and grain storage facilities, farm buildings, and animals	Contamination of air, soil, and water resources; potential danger to human health and food safety	Pesticide and Fertilizer Applications • For lawn, tree, and shrub care, gardens and parks • Vegetation control programs for street boulevards, utility right-of-ways, parking lots, easements, waterways
Water Runoff • From croplands, feedlots, other animal confinement facilities, grain storage areas	Contamination of soil and water resources, increased waterway and aquifer management challenges and costs	Water Runoff • From gardens, lawns, and chemically treated house foundations
Soil Erosion and Soil Health • From water and wind, over-cropping, poor tillage practices, deforestation, monocropping, inadequate crop rotation	Loss of top soil, waterway contamination, respiratory problems, soil nutrient depletion	Soil Erosion and Soil Health • From water- and wind-inadequate crop rotation and vegetation coverage of gardens, drainage channels, monocropping, new subdivisions
Water Limitations • Watershed and aquifer depletion • Drought	Water rights issues, irrigation restrictions, crop losses, increased waterway and aquifer management challenges	Water Limitations • Watershed and aquifer depletion • Drought
Animal Carcass and Crop Residue Disposal • Recycling/Composting	Contamination of air and water, cost of waste disposal and composting facilities, human safety	Garbage Dumps, Landfills, Yard Waste Disposal • Recycling/Composting
Energy Consumption and Fuel Efficiency of Equipment and Practices	Depletion of natural resources, air contamination, ozone pollution, high energy cost	Energy Consumption and Fuel Efficiency of Equipment and Practices
Human/Community Capital • Labor shortages • Limited youth activities • New immigrant communities • Shortage of young farmers • Shortage of local investment	Inadequate community leadership and collaborative problem solving capacity, crime and delinquency, population change (in some cases, out-migration), community conflict	Human/Community Capital • Labor shortages • Limited youth activities (e.g., inner cities) • New immigrant communities • Hobby farmers with limited farm/business experience

Figure 8.1. **Common problems and potential impacts within the rural-urban agroecosystem. The commonality of the problems and impacts suggests that potential solutions may have application to both rural and urban populations. This idea further substantiates the value of rural-urban partnerships to preserve natural resources, maintain business and economic viability, control pollution, and build healthy and livable communities. Pooling financial and human resources can generate solutions more quickly and with increased economic benefits. By applying an integrated rural-urban approach, shared problems can become jointly owned solutions that produce pay-offs for everyone.**

both economic and resource (human and natural) availability and replenishment. If the often competitive needs of both urban and rural areas are not integrated, however, outcomes may lack elements that contribute to regional competitive advantage and problem-solving capacity.

The following domains for collaborative problem solving have been identified by the CAST report: (1) comprehensive planning, (2) public policy, (3) higher education, (4) research, and (5) partnerships and collaboration. Each category includes initiatives that could enhance research, education, problem solving, and planning.

Comprehensive Planning

As indicated in this report, urban agriculture is a complex and dynamic endeavor involving many activities, purposes, attributes, and outcomes. Because it is an integral part of the urban economy and ecology, it should be part of the comprehensive planning process. Land-use planning and agricultural planning, for example, will include many pragmatic dimensions as well as input from and collaboration with diverse groups. Many individual pieces of the metropolitan agriculture puzzle are identified, but planning is needed sorely now to put these pieces together into a coherent and functional whole. In international cities such as Dar-es-Salaam (Tanzania), Kampala (Uganda), Ho Chi Minh (Vietnam), and Shanghai (China), urban planning includes agriculture by identifying publicly controlled zones that prohibit certain types of farming, by identifying "green belts" for community gardens, and by establishing buffer areas to help control development and protect urban soil (de Zeeuw, Gundel, and Waibel 1999).

Urban agriculture is a tool that can be used in a comprehensive planning approach to address farm and nonfarm issues related to community livability, environmental and natural resource conservation and use, and local economic vitality. Six comprehensive planning initiatives to consider are the following:

1. **Public support.** Without an understanding of the rural-urban agroecosystem or the role that both rural and urban partners play within it, public support for institutional or policy change will be difficult to gain. ***Efforts must be made to help both rural and urban residents understand and appreciate the broader applications of agriculture and its potential for helping to resolve common problems.*** A key strategy involves the engagement of community and agricultural leaders and public officials in identifying mutual needs and opportunities.
2. **Integrated, long-term rural-urban resources.** ***The multidimensional issues and needs of urban, urban-edge, and rural agriculture must be incorporated into long-term comprehensive economic, environmental, and social development plans.*** Natural and cultural amenities, many located outside urban areas, are valuable assets, especially as populations expand and move away from their agricultural roots. Incentives for rural-urban cooperation can offer attractive pay-offs to all participating partners. Cooperative funding initiatives will be needed to help manage common resources such as watersheds and estuaries, energy sources, and natural habitat areas.
3. **Community food systems.** ***Planning for a functional, safe, and sustainable urban food system requires that residents and organizations understand their existing food systems and identify local or regional goals for a desired food system.*** Elements to consider include food sources, value-added production and processing potentials, customer-producer relationships, biowaste recycling, energy sources and costs, economic and community development, individual health, land use, and food security. Another consideration might be institutional or government purchases of local or regional agriculture products.
4. **Financial incentives.** ***Low-cost loans, technical assistance, and other financial or tax incentives for entrepreneurial urban agricultural business activities, alternative and niche production opportunities, public gardens, environmental site restoration, wildlife habitat development, farmland protection, waterway remediation, groundwater recharge, scenic beautification, and interiorscaping for aesthetic and therapeutic values should be provided.***
5. **Funding.** ***Creative community-based revenue generation to support the outcomes of joint planning (e.g., community grants, volunteer contributions, business-community partnerships, and fee-for-service activities) should be explored.*** Some of the resources often taken for granted could have a cash value that would instill local pride in the asset.
6. **Existing resources**. ***Planners should consult***

with the many research-based information resources for agriculture, including services within the USDA (e.g., the Cooperative State Research, Education, and Extension Service [CSREES] and the Natural Resources Conservation Service [NRCS]), which provide information about soils, plants, water, and waste handling systems. Land-grant universities and metropolitan colleges and universities, non-profit organizations such as AFT, and botanical gardens are additional sources of information.

Public Policy

Academicians and others have advocated strongly the decoupling of agricultural policy from rural community development policy because of the former's traditional focus on commodity production and the latter's on social and economic needs in a changing society. Relatively few of the nation's policies have addressed the role of agriculture within metropolitan and rural areas. Urban agriculture is at the interface of agricultural enterprises, local communities, and the natural landscape. This interface requires that public policy address the common *and* unique needs of each component. Important aspects of this policy process, and the common ground they share, are land-use planning, planning for agriculture, and long-term food security. Embedded in the planning and food security issues are the sustainability and the viability of natural resources and ecosystems and the development of alternative policies preserving the capability to use these resources wisely while ensuring quality of life. As new policies are developed and current policies scrutinized, assessments of their effects must be made regularly to support informed decision making by policymakers and local leaders.

Farm subsidy payments can hurt rural communities by absorbing financial resources. This practice limits the availability of funds to encourage rural communities to work in partnership with urban neighbors. At the same time, current farm policies omit certain types of farm businesses (e.g., turf and vegetable, fruit, greenhouse, nursery, and other specialty crops) often found in MAs. A need exists to reorient agricultural policy toward programs equitably supporting diverse farming and/or food systems to strengthen the relation between rural and urban areas and to promote natural-resource stewardship. Policies also should reflect the realities of the kinds of current systems, the public support that exists for family farmers, and society's goals for more sustainable food, agriculture, natural resource, and community systems to meet the needs of future generations.

The need for reform in U.S. farm policy was reinforced by a recent AFT national public opinion survey of registered voters, which indicated overwhelming public support for the many services that farmland provides, including food and fiber production, wildlife habitat, scenic vistas, ecosystem services, ground-water recharge, and "agritainment." The public supports the use of farm subsidy payments to help family farmers under stress from low market prices, floods, or drought, and to encourage improved conservation and stewardship practices (AFT 2001b).

Equitable rural and urban policies must be tailored to a region's identity and needs as well as to the welfare of its residents. The following three dimensions should be considered in the shaping of future urban agricultural policies: land use, food systems, and human capital development.

Land Use

As urban areas continue to grow and to sprawl, they change the landscape by altering or eliminating ecologically valuable land and forest resources. Land fragmentation has become an important issue at the urban fringe. The spread of urban boundaries and human populations into rural areas alters the landscape in terms of its economic, social, cultural, and natural functions and values. How can these changes occur and how can they be mediated? The following suggestions are offered to address some of the challenging agricultural land-use policy issues.

1. **Analysis of alternative policy instruments.** ***A crucial need exists for cost effectiveness analyses of alternative land-use policy instruments*** (e.g., rural zoning, urban growth boundaries, tax incentives, and agricultural conservation easements). Alternative tools for farmland and open-space protection and management need to be compared by means of selected case studies. Because land-use change tends to be a regional phenomenon, regional technologies for guiding growth also should be analyzed for cost, effectiveness, and distributional issues. Who pays, who gains, and who loses under rural zoning, easement purchase programs, or tax incentives? Political positions are taken based on who is asked to pay the bill for protecting open space. Alternative policy scenarios, including subsequent effects, are needed.

2. **Land conversion data needs.** ***Need exists for documentation of land conversion from agriculture to other uses***. Data from actual transactions are needed to augment the NRI and the *Census of Agriculture*.
3. **Land-use decision making.** ***Various physical, economic, and demographic variables should be integrated to develop improved spatial models of land-use patterns to design local policy.*** A useful activity in this regard would be to assemble scientists in several disciplines working on land-use models for a national workshop on predictive land-use models, with applications for real situations.
4. **Analysis of real local decision processes.** Agricultural preference zoning, for example, suggests that certain land areas will remain in active farming, thus prohibiting nonfarm development. In practice, zoning amendments, variances, petitions, referenda, and other practices determine how land is used. ***Actual land-use decision making behavior within institutional and /or governmental frameworks should be documented.***
5. **Roles for government and higher education.** ***Appropriate roles for federal, state, and local governments in land-use policy development and implementation should be identified.*** Processes should be included for constituent engagement and solicitation of recommendations. Opportunities for improving how the Federal Farmland Protection Program is integrated with state, local, tribal, and nonprofit farmland protection programs, other conservation programs, and overarching growth management plans should be identified. Items to consider include an evaluation of fund allocation criteria; an analysis of opportunities to enhance the leveraging of landowner donations; an assessment of how to maximize environmental benefits of protected parcels by connecting them with natural corridors; an assessment of the potential to target protection of farmland in high-priority areas; an evaluation of program success measures; and a quantification of the environmental benefits associated with farmland protection. Public and private organizations are in a good position to collaborate on training programs targeting land use and agriculture land protection issues, policies, tools, and case experiences.

Food Systems

The interdependence of urban and rural life is represented historically in the relationship between the production of food, fiber, and wood products and the urban markets where these value-added products are consumed. Although globalization, restructuring within the domestic agricultural system, and demographic changes have obscured the relationship between producers and consumers, product cost, quality, and safety continue to be important issues to everyone.

1. **Food access and advocacy.** ***Policies should be developed to ensure that all residents have access to local, affordable, safe, and nutritious food.*** Food policy councils (FPCs) exist at the state level in two states and in approximately 16 other communities in the United States and Canada. Several additional states (North Carolina, Utah, Kentucky, Oklahoma, and Massachusetts) are considering cooperative food policy arrangements and FPC formations. An FPC is an officially sanctioned group of people representing different elements of a state or local food system and charged with making recommendations regarding improvement of the food system. An FPC can contribute in other ways as well (e.g., by serving as a forum for understanding individual actions and their effects on other parts of the system, monitoring food systems, improving access to and quality of the local food system, pushing for more comprehensive policy initiatives, conducting public education and research, and promoting more sustainable food systems) (Hamilton 2001). State legislators should consider seriously the formation of FPCs and other types of food system coalitions. Coalition activities could include exploration of regional opportunities for promoting unique rural-urban amenities and enterprises.
2. **Localized economic and community benefits.** ***State and local government policies should be used to provide local and regional support for production, distribution, and use of food and food products originating in the area.*** Support should be given to farmers' markets, farm stands, CSAs, and other direct farmer-to-consumer marketing mechanisms (e.g., through land allocation, state agency support, and promotion). Also included might be state programs to purchase local food for state institutions, and tax incentives to encourage retail out-

lets to take advantage of locally available foods.

3. **Food security and nutrition.** ***Who consumes what products, in what quantity, and at what costs in a given period of time are important market issues. There are also vital social and cultural issues when access to affordable and nutritious food is unequal among particular societal groups.*** Many governmental and local community programs exist to serve these groups. As federal and other governmental policies decrease the size of the U.S. social welfare program, disadvantaged groups and their patterns of consumption relative to where they live must be monitored continually. Programs such as the Community Food Security Program and others under the USDA's Food, Nutrition, and Consumer Services auspice need continued public funding and support.
4. **Converting and revitalizing vacant or underused urban lands.** ***Policy initiatives are needed to convert or revitalize underused or misused urban land to encourage more localized food production and access and to increase knowledge of horticulture and other food-related activities.***

Human Capital Development

There is much evidence that farming, as an occupation, no longer is attractive to the greater portion of the U.S. population. This fact is reinforced by the increasing average age of the U.S. farmer and by the decline in numbers of individuals with a direct tie to production agriculture. Even when immigrants migrate to rural communities for agricultural labor purposes, their migration and stay often represents a temporary situation. Immigrants frequently leave a rural area as soon as they can find work in a metropolitan one. Many new residents have a background in agriculture and entrepreneurship from other countries. Yet little effort is made to encourage them to remain in the agricultural sector at a managerial or ownership level. Questions to help frame policy are as follows:

1. **How can a new generation of entrepreneurial farmers evolve? What type of policies are needed to offer mentoring and incentives for new farmers and ranchers?** For example, might states identify ways to mentor and to encourage urban entrepreneurs, immigrants, or women interested in entering farming or ranching as a profession? How can policy promote the development of needed skills for more sustainable production and marketing systems appropriate to smaller, more intensive land parcels in urban neighborhoods?
2. **What is the role of agricultural policy in creating a new generation of successful agriculturalists who can adapt to the needs of a more urbanized society? Could policy foster a healthier balance between large-scale corporate agriculture and small to midsized family farming systems that exist within or near MAs?**
3. **What programs can be developed to help young farmers or ranchers gain access to needed capital?** There may be ways for young and more experienced farmers to partner in adapting a farm enterprise for the future.

Higher Education

Since the passage of the Land Grant Acts of 1862 and 1890, the study of agriculture has been perceived by many people as largely under the purview of LGUs. Furthermore, urban studies have been perceived as mainly unrelated to agriculture and under the domain of non-LGUs, or at least outside of colleges of agriculture. For urban agriculture to reach its potential, LGUs, non-LGUs, and colleges within LGUs must work together to educate students (through formal learning processes) and the public (through informal learning processes). Metropolitan universities and colleges are among the key players in such future relationships. A great number of these institutions offer exciting undergraduate courses and graduate programs focusing on problems of the rural-urban interface (e.g., University of New Orleans, Cleveland State University, University of Southern Maine, University of North Carolina–Charlotte, The Evergreen State College, and Tufts University). Some specific opportunities for higher education include the following:

1. **College and university curricula.** ***College and university curricula, including general education requirements, should be strengthened to ensure that urban agriculture issues are addressed in an interdisciplinary, systems-oriented manner.*** The rural-urban agroecosystem concept and the interdependency that exists between the sectors should be developed further. Curricula should include subject matter

integrating such areas as resource allocation and management, horticulture and forestry, agroecosystems analysis and services, food systems, conflict resolution and consensus building, social and cultural change, conservation and environmental protection, technology's social impacts, IPM, urban soils, land and water, policy and planning, landscape design, and applied/participatory research. Learning processes engaging students in real-world issues and problems faced by people in communities, governments, and the private sector should be encouraged (Figure 8.2).

Figure 8.2. A faculty member points out qualities of a pond-raised hybrid striped bass for a student studying fisheries science at Delaware State University. Photo by Scott Bauer, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Maryland.

2. **Outreach and extension.** ***Extension outreach programs could be strengthened in several areas. Following the lead of some, all LGUs should establish a rural-urban interface team to initiate collaborative partnerships between urban leaders and planners and to develop educational and outreach programs addressing problems within the rural-urban agroecosystem***. Three important focal areas are food systems, agricultural land and open-space protection, and building entrepreneurial capacity.

   - **Food systems.** ***Food-system learning projects should be initiated.*** These projects will monitor and analyze the food systems in particular communities or regions; improve access of low-income residents to food sources by improving transportation or by influencing retail outlet location decisions; advocate for, and establish, community gardens for affordable and fresh produce; facilitate food-related employment and entrepreneurship; educate residents and leaders about issues related to nutrition, grocery shopping, gardening, food buying and marketing, food preparation, and policy; encourage sustainable food production and distribution; strengthen linkages between local farmers and consumers; devise innovative hunger-prevention programs; provide leadership to involve community leaders in the development of community food security provisions and to formulate food and agriculture policy recommendations at various government levels.
   - **Agricultural land and open-space protection.** ***More emphasis needs to be given to extension and applied research programs in the area of agricultural land and open-space protection. Such efforts need to be developed thoughtfully to ensure neutrality and balance in addressing the needs and interests of all stakeholders, without favoring any interest group over another.*** Public education based on solid data is needed about how agriculture contributes to the community and how much it contributes economically. One important aspect to address is the issue of how much "critical mass" of farming and associated infrastructure is needed to sustain benefits. Extension also can assume leadership in documenting and disseminating successful farmer adaptation strategies. Where extension has helped in the process of farmland and open-space policy development, it is important to document the processes used, and especially those that have been successful. How have stakeholders been identified and en-

gaged? This information would be useful if it were written up in case study form and shared with other communities developing participatory processes and policies for farmland and open-space protection (NRCRD 2001).

- **Building entrepreneurial capacity.** ***American economic success is rooted in entrepreneurship. Extension can play a key role in stimulating entrepreneurial partnerships between rural and urban constituencies and in assisting communities in identifying market opportunities and customer preferences.*** Chances for success can be increased when rural communities establish direct connections to urban leaders and decision makers, market outlets, and consumers. Extension can also provide entrepreneurial leadership training and support for the organization of farmer marketing alliances.

3. **Bridge building.** ***Programs should be developed to resolve conflict and to build partnerships between urban and rural users of agricultural information and technology, especially to serve commodity groups, other special interest groups, and urban user groups.*** Special attention should be paid to learning about the needs, interests, and priorities of urban-oriented organizations such as the Urban Land Institute, National League of Cities, National Governors Association, National Association of Towns and Townships, American Planning Association, and National Association of Counties. Where possible, LGUs should be encouraged to partner with, and learn from, urban-oriented and other appropriate nonprofit groups such as the AFT, Kellogg Foundation, and Audubon Society. Such partnerships offer a timely opportunity for LGUs to demonstrate where and how agriculture can contribute to organizational agendas.
4. **Public education and promotion.** ***Public education to improve understanding between rural and urban populations about the interdependency of these sectors and the potential contributions that agriculture can make to improved quality of life, economic enhancement, resource conservation, and environmental preservation is needed.*** Distance education technology offers significant opportunities for reaching out to a variety of place-bound audiences about the issues of urban agriculture and their relevance to urban life. The subject matter of agriculture must be presented to people of all ages, in light of current trends towards urbanization. This presentation will call for an updating of curricula offered by such programs as Ag in the Classroom, 4-H, and Future Farmers of America (FFA). Opportunities exist to work through programs such as Master Gardeners, Master Composters, and docent programs in botanical gardens to offer holistic strategies for urban agriculture, including issues of rural-urban interdependency.
5. **Professional development.** ***In-service training programs should be established for college and university faculty and staff to help them deal effectively with the emerging urban agriculture-related issues addressed in this report.*** Opportunities to include an urban agriculture curriculum in the training of public school teachers and other youth educators should be identified.
6. **Internal planning and organization.** ***Higher education can benefit by sharing resources, searching out new sources of funding, and addressing rural-urban agroecosystem issues.*** Some sharing may be made possible by means of creative reallocation of existing monies; it will be essential, however, to seek the support and the participation of new partners. Resources should be refocused on issues beyond commodity-based agriculture, to include holistic strategies and content more appropriate to the changing rural and urban agricultural situation. Careful planning will be needed to identify a cross-disciplinary mechanism or structure that will foster a systems approach for responding to common urban-rural agricultural opportunities.

Research

The clear need exists for more science-based information in designing, developing, and managing urban environments. Without a strong science base, decisions too often are made solely on the basis of factors such as financial gain, political influence, and public sentiment. Such decisions may seem to work in the short-term but have negative long-term consequences. Research opportunities related to urban agriculture, as broadly defined in this document, have not been clearly articulated or enumerated in writing. Key areas of research need to be identified for the agricultural, biological, and social sciences. Active engagement with urban and rural community leadership will help individuals refine and focus this

research agenda and assist in defining researchable problems and matching research needs with the capabilities of universities, governments, and industries. Without rural and urban input and buy-in, it is unlikely that sufficient funding will be generated to meet the multifaceted research needs associated with urbanization.

1. **Plant adaptability and production systems.** Plants perform many important functions in the urban environment, which often is not conducive to plant growth and development. There are needs, therefore,
   - to identify and/or to develop, through plant evaluations and plant breeding, landscape plants better suited for the rigors of the urban environment;
   - to identify visually acceptable native plants that can be produced economically;
   - to develop small-statured landscape plants that better fit the restricted landscape spaces common in urban environments;
   - to develop plants that are biosensors, to monitor specific environmental hazards such as radioisotopes, built-up soil chemicals, and fuel contaminants. Currently, a cost effective way to monitor many environmental hazards may not exist. These and other future roles for plants to monitor the environment may prove invaluable;
   - to develop diverse and environmentally friendly crop-animal production systems incorporating value-added options (agritourism, farm-based processing, etc.) suitable for smaller-acreage urban environments; and
   - to develop landscape plants that are shade tolerant, to accommodate urban landscape needs.
2. **Urban soils.** In urban environments, soil is an important natural resource influencing plant performance and providing engineering functions. Research is needed
   - to manage soil fertility for optimal plant health while minimizing negative environmental effects;
   - to develop cost-effective compost systems;
   - to improve urban soil quality (structure, chemistry, and biology). Waste composting and utilization offer the potential for urban soil improvement;
   - to determine when and how best to utilize inorganic amendments such as sands, ashes, and expanded clays and shales to improve soil porosity and water infiltration;
   - to remediate soils contaminated with industrial wastes;
   - to develop turfgrass varieties that sustain vehicular and pedestrian traffic while accommodating storm water; and
   - to evaluate the basic properties of urban waste materials including biosolids, food residuals, coal combustion ashes, and municipal yard waste compost and to determine how to use these materials judiciously as soil amendments in potting mixes and urban gardens or as backfill material for tree wells, street medians, and so forth.

Figure 8.3. **A plant pathologist examines cultures of different root pathogens that can reduce yields of strawberries grown in poorly or nonfumigated soil. Photo by Scott Bauer, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Maryland.**

3. **Water management.** Urban water issues, especially in the western and southern United States, where MAs have been increasing, are characterized by increasing conflict due to the demand for high-quality water for urban consumption, industrial processes, and irrigation. Accordingly, an acute need exists for research
   - **to develop water conservation programs and landscape designs leading to more efficient use of water;**
   - **to identify and/or to develop landscape plants requiring less water;**
   - **to develop more efficient irrigation systems increasing water use efficiency;**
   - **to develop improved landscape management techniques aimed at decreasing the negative effects of fertilizer and pesticides on surface- and groundwater quality;**
   - **to identify appropriate construction materials and designs for construction of groundwater recharge systems and wetlands that can be used to control the quantity and quality of urban storm-water runoff;**
   - **to develop total maximum daily load (TMDL-maximum pollutant load capacity) for a body of water and land in urban watersheds, for the purpose of designing remedial systems to restore water quality; and**
   - **to characterize the ecological risks associated with water re-use programs of industries and municipalities.** Based on this characterization, alternatives can be developed for improving management and decreasing ecological and health risks.
4. **Pest management.** Urban landscapes face challenges from insects and plant pathogens. Additionally, there are other pest concerns (termites, spiders, etc.) associated with built structures and with human diseases (Lyme disease, Nile Virus, etc.) transmitted by insects and wildlife. In urban environments, however, pesticide usage is a serious concern and likely will face increasingly stringent regulation. There is a need for research aimed at developing more environmentally-friendly pest management strategies. This need includes development of
   - **insect- and disease-resistant plants;**
   - **IPM and biocontrol systems of plants, insects and diseases** (Figure 8.3);
   - **structural pest-management strategies (e.g., control of household pests, wood-destroying pests, and pests that invade structures such as airplanes, docks, ships, railroad cars, or trucks) posing minimal risks for humans and the environment; and**
   - **safe methods for discouraging wildlife from feeding on valuable landscape plants, for selecting plants resistant to animal feeding, and for preventing transmission of animal diseases to humans.**
5. **Entrepreneurial products.** ***Advancements in science and technology have created opportunities for new products and services***. Agricultural science has made it possible to create several revenue streams from any one product (e.g., extraction of plant and animal compounds for treatment of health ailments, production of food preservatives, or generation of energy and energy byproducts). These new developments create a need for documentation of economic feasibility, marketing and production budgets for products or services such as biofuels, neutraceuticals, waste utilization, alternative composting technologies, site remediation, natural resource management, and individual health care services. Through creative partnerships, rural and urban areas can work together to create a variety of value-added products and services.
6. **Social and economic dimensions.** ***There is limited understanding of the general public's attitudes, perceptions, and knowledge of the contributions of urban agriculture***. Part of society's challenge is to build public recognition of the reciprocal value existing between rural and urban sectors and of the positive role that agriculture, in its broadest sense, can play. There also is a continual need to understand consumer trends and demands regarding agricultural product and service expectations, especially those related to individual and community health and well-being. Research should be conducted on the following topics:
   - **Public attitudes and perceptions**. ***National and local studies using targeted focus groups should describe the general public's understanding and perceptions of agriculture's role in rural and urban so-***

cieties. A national survey should investigate the degree of differentiation that the public makes between the two sectors, for instance, whether the public distinguishes between rural and urban agriculture, and how it perceives urban sprawl.

- **Connections and common interests**. ***Relatively little understanding exists of the actual connections and common interests between farm and nonfarm (or rural and urban) people and organizations. Given this type of insight, people could be m***ore able to take advantage of existing social networks and common denominators for improved rural-urban policy planning.
- **Individual and community health and well-being.** ***Research is essential to document the effect that plants have on health and well-being of individuals and communities in diverse settings and cultures***. These effects can include environmental, therapeutic, and economic applications. Researchable areas include plant and animal roles in prevention and recovery from major illnesses, and in stress reduction; effects of plants and animals on decreased cost of health care; children's plant and animal interactions and their developmental benefits; plant and animal effects on worker productivity and absenteeism; and effects of attractive and well-planned landscapes on commuter stress mitigation.

7. **Farmland protection.** A conference sponsored by the American Planning Association, The Center for Agricultural and Rural Policy, The Northeast Regional Center for Rural Development, The Swank Program in Rural-Urban Policy (The Ohio State University), and others was held in September 2001 to examine the regulations surrounding land-use management (agricultural protection zoning, right-to-farm laws, and urban growth management regulations) and to identify the knowledge gaps concerning the effectiveness of these policies (NRCRD 2001). Conference participants, including leading scholars and program managers, generated recommendations to strengthen the research agenda on farmland and open-space protection. The section that follows draws on the proceedings of this conference, as well as on the suggestions of the CAST authors. The recommended areas of research are as follows:

- **Problem clarification.** ***Documentation and understanding of the nature and the amount of converted farmland should be improved, as should documentation and understanding of farmers' adaptations to changes at the rural-suburban fringe.*** Topics that should be considered include related outcomes; population changes in places where farmland and open space are under threat; personal and family factors affecting farmers' decision making in the face of threat; effects of industrializing the food system on farmers' decision making about land conversion; economic effects of farmland loss on communities; role of agriculture in local, regional, and state economies; location choices and preferences of residents and roles of organizations affecting choices; and factors influencing development of farmland and open space. Questions to be addressed include: What is the critical mass of farms and associated businesses needed for long-term farm viability? What is the nature of "sprawl" and what are its impacts on agriculture? How can agriculture help mitigate the problems of population growth and sprawl? What are the population growth trends and the amount of agricultural land used for development?
- **Public preferences and values.** Public perceptions of farmland, including values and preferences and perceived positives and negatives, are important for planning purposes. Do people want farms and the accompanying changes of economic viability, or do they want the amenities that come with living near farms? People's willingness to pay for the outcomes of farmland and open-space protection policies should be documented. ***Rural and urban stakeholders in farmland policy should be identified, as should their goals, including convergent and conflicting goal sets and policies.***
- **Integration of policy tools.** ***Integration of policy goals should be improved, as should analytical methods, policy tools, and governmental boundaries.*** Improved understanding of farmland protection goals to ensure that policy design meets stakeholder preferences is called for. Multidisciplinary studies helping explain land conversion decisions and stresses could be used to help formulate public and private responses to farmland and open

space loss. Insights from family sociology, conflict resolution, legal, financial, and other human dimensions might aid in the consideration of certain complex problems. Because policies often are used together, the potential complementarity (or conflict) of different policy tools is an important issue, as is the means of evaluating "blended" policies. How to apply policies across political boundaries effectively, and what the outcomes may be for different stakeholders and jurisdictions, need to be understood more clearly. Evaluation of existing regional growth management programs would be useful.

- **Effects of farmland protection policies.** Limited research has been done to document agricultural land protection policy options and their effectiveness. ***Studies are needed to ascertain the true effects of policies on property values, to learn the effects of granting variances to agricultural zoning, and to understand the unintended consequences of farmland and open-space protection policies, including second- and third-level effects.*** What are the implications of policy designs emphasizing common group goals, and how are individual interests affected? Advancing conceptual designs for policy evaluation and implementing comparative evaluation studies across states are necessary steps. There also is a need to measure and to understand the effects of land-use fragmentation (or "leapfrog" development) on agriculture, aesthetics, and wildlife habitats. Another important issue is the need to understand the environmental benefits of working agricultural lands in urban-influenced areas.
- **New policy tools.** ***Research on farmland and open-space protection needs to be more creative.*** Approaches can include identifying new funding sources for PDRs; using multidisciplinary teams to understand farmers' departure from farming, and, subsequently, applying these findings to interventions; creating multidisciplinary studies of development patterns at the rural-urban interface, including roles and motivations of different stakeholders; examining interactions among policies, farmers, and residents at the rural-urban fringe, including insights into successful farmer adaptations; documenting who benefits and who pays as a result of these programs; engaging in systems-oriented studies of the relations between farmland protection issues and other issues such as housing, and identifying stakeholders; and clarifying the political and institutional connections.

Partnerships and Collaboration

Historically, agricultural commodity and allied industry groups have been the voices of agriculture. By providing financial and political support and advice, these interest groups have had a major influence on the traditional agricultural system. Generally, they have defined their interests as rural; consequently, they probably have not appreciated the value of an urban partnership fully. Likewise, urban populations probably have failed to appreciate fully the value of partnering with rural constituencies. The changing agricultural support base, increasing environmental concerns, diminishing natural resources, and increasing public demand for recreational and open spaces will continue to make rural-urban partnerships extremely important. If agriculture is to survive, albeit in a different form, in an urbanizing society, partnerships between traditional agricultural groups and urban interest groups will be imperative. These new relationships hold promise for all participants and have the potential to secure new resources, to preserve productive agriculture land and open space, to control sprawl, to maintain equitable access to natural resources, and so on.

Partnerships and coalitions among diverse organizations can play a crucial role in solving problems and creating new opportunities, especially when urban agricultural issues are so complex, multidimensional, and often unprecedented. Urban agriculture can attract a wide group of stakeholders, ranging from individuals in higher education to those in state and local governments or in the private sector. Government agencies include those with nonagricultural orientations such as planning, environmental health, economic development, and tourism. Together, a coalition of broad-based interests could be a formidable force with which to address the opportunities and challenges of urban agriculture.

Regardless of one's institutional affiliation, the advantages of expanding relationships beyond those within the organizations with which one normally associates are many. For urban leaders and planners, establishing ties with agricultural partners can lead to new knowledge, information, and resources. For

rural and urban leaders, establishing partnerships opens opportunities to connect the two sectors, thereby expanding resources, generating economic opportunities, and providing better customer insights. For nonprofit organizations, new partnerships can expand the scientific resource base and enable development of an area of expertise pertinent to their missions. The private sector can benefit from university partnerships by accessing new science-based knowledge with which to strengthen the competitive advantage. Partnerships between agencies and urban leaders can help businesses through product exposure and can provide timely insights into urban needs and priorities.

As the agricultural agenda shifts towards urban interests, LGUs have an opportunity to reposition themselves in response to societal needs. Land-grant universities, whose mission includes outreach and service to all of society, must identify new and creative ways of doing business to reach their full potentials in an urbanizing environment. The enormous intellectual capital held in LGUs has the capacity to help fuel an urban agriculture success story paralleling that of the rural agricultural agenda over the past 100 years. The urban agricultural agenda offers LGUs a unique opportunity to engage collectively both urban and rural constituents. Strong relationships between urban leaders and organizations bringing a different set of experiences and perspectives to the table can strengthen both rural and urban areas and the agricultural institution itself. Land-grant universities have an opportunity to reinvent themselves by devising strategies to service rural needs while simultaneously adapting science and services to meet the needs of a growing urban sector.

The challenge is to build new strategic partnerships and new forms of public support while responding to the expectations of traditional clientele. The engaging of new partnerships will require leadership and focused efforts in which common problems, goals, and agendas are shaped together, for mutual benefit. The value of diverse partnerships, for example, with K–12 education, community colleges, and other public and private four-year institutions of higher education, has been articulated clearly in reports by the Kellogg Commission on the Future of State and Land Grant Universities (1999, 2000). According to the commission, universities must continue to change to meet societal expectations. One way to accomplish change is to create two-way partnerships defined by mutual respect and joint commitments to finding solutions to real societal problems. Issues to be redefined in more contemporary terms include education and the economy, agriculture and food, urban revitalization, and environmental and natural resources. The "urban-rural common ground" concept, to which this report directs attention, fits clearly within the Kellogg Commission mandate. The questions that this CAST report raises require a range of problem-solving, financial, and other resources. Six suggestions are provided to stimulate ideas about potential partnerships through which to address the complex issues of the rural-urban agroecosystem.

1. **Expanded representation.** ***The strength of partnerships is the breadth of experiences and backgrounds brought together. This is the crucial mandate of urban agriculture and will call for coalition building among diverse organizations whose agendas correspond with certain components of the rural-urban agroecosystem.*** Key partners include the following:

   - **Higher education.** The LGU departments (e.g., sociology, psychology, marketing, political science, languages, ethics, history, architecture and landscape design, urban planning, engineering, environmental sciences, extension services, and various agricultural sciences), community colleges, private universities, and medical and technical schools.
   - **Government agencies.** County/state leadership (e.g., commerce and trade, tourism, planning, transportation, parks and recreation, community and economic development, land use, and agriculture) and federal agencies such as the Department of Education, the Environmental Protection Agency (EPA), the USDA Sustainable Agriculture Research and Education, CSREES, the Food and Drug Administration, the National Institutes of Health, the National Science Foundation, and departments of public works.
   - **Nonprofit organizations and other associations.** Botanical gardens and arboreta, zoos, community food coalitions, community gardens, greening organizations, the faith community, conservation, wildlife and environmental organizations (e.g., Audubon, Sierra Club, Ducks Unlimited, AFT, Land Trust Alliance, Trust for Public Lands), private foundations (e.g., W. K. Kellogg, Kerr, Noble, Mott), sustainable agriculture, and consumer advocacy. Associations include such groups as the Urban Land Institute, The National

League of Cities, The National Governors Association, National Association of Towns and Townships, American Planning Association, and National Association of Counties.

- **Private sector firms.** Green industry, landscape firms, tourism industry, processing and distribution businesses, retail outlets, hospitals, nursing care facilities, and agronomic and equipment firms.

2. **Partner engagement.** ***The urban agriculture agenda offers higher education an opportunity to involve the entire campus community in solving complex urban agriculture problems. Furthermore, developing a multidisciplinary university effort in partnership with both urban and rural communities, public and private agencies, and private industry offers an excellent holistic model for developing programs addressing contemporary societal needs.*** Opportunities for off-campus partnerships include the following:

   - **Community food systems partnerships.** Building partnerships between farmers and more urban-based groups (e.g., horticulture associations, food systems councils, consumer advocacy organizations, and farmers' markets) could be very beneficial. One example could include the integration of CSA initiatives (whereby consumers share the risks and benefits of farming) with the agenda of a food policy council concerned about state or local food policy. Community food projects can connect food producers, consumers, and local food systems to community objectives such as improved local health and diet, public education, food access, youth development, and recreation.
   - **Community greening partnerships between urban and rural areas.** The American Community Gardening Association, for example, is composed of various professional groups and volunteers who believe that gardening and landscaping activities are catalysts for neighborhood and community development.
   - **Government, nonprofit organizations, and community partnerships.** The Urban Resource Partnership (URP) is a USDA initiative encouraging neighborhood conservation partnerships for education, resource protection and enhancement, and community development. The URP effort also is supported by partnerships with other federal agencies. The NRCS partners with AFT to support the Farmland Information Center and to supply farmland protection information.
   - **Wildlife and recreation area partnerships.** For example, the Audubon Cooperative Sanctuary System, a partnership between Audubon International and the U.S. Golf Association, encourages golf courses to develop resource management programs to improve environmental quality for both people and wildlife.
   - **Watershed protection partnerships.** The New York City Watershed Protection Programs, established under the 1996 Watershed Agreement, reflect a partnership among upstate New York watershed communities, environmental organizations, New York City, New York state, and the EPA (Pfeffer and Wagenet 1999). At stake is 1.4 billion gal. of high-quality drinking water for daily consumption by almost 9 million New York City residents. This partnership implements a comprehensive management and water quality enhancement program to protect the watershed, the drinking water supply, and the economic viability of the agriculture-based economy within the watershed communities.

3. **Future faculty roles.** ***The urban agriculture agenda calls for integrated and interdisciplinary discovery, learning, and engagement approaches within universities. Faculty participating in these collaborative activities run the risk of not being rewarded by their institutional culture unless evaluation and reward guidelines are adapted to recognize individual contributions to the whole partnership.*** This calls for revision of traditional reward systems based solely on refereed journal articles, grant dollars received, and individual achievement. Recognition of creativity and collaborative scholarship will be an important motivator to entice faculty contributions to partnerships associated with complex urban agriculture problems (Boyer 1990).

4. **Cooperative extension.** ***Extension remains one of the country's most unique mechanisms for reaching beyond the university campus into constituent communities.*** Nationwide, there are 74 LGUs classified as 1862 or 1890

LGUs, 30 LGUs classified as 1994 institutions, and 3,150 county administrative units. In 1999–2000, there were 32,000 extension employees and 2.8 million extension volunteers. In 1997 (the last year for which data are available), staff in extension reached more than 110.5 million U.S. residents. In spite of the strength of these resources, most extension personnel are not situated in metropolitan counties, and fewer yet are addressing rural-urban agroecosystem issues/problems. The following suggestions offer means of strengthening extension's effects in this important area:

- **Broaden campuswide extension partnerships to provide a wider base of expertise on urban agriculture issues.**
- **Offer educational opportunities to orient organizations about the values of urban partnerships**. Develop a team approach that includes key urban agroecological elements (e.g., forest and natural resources, social and economic, environmental, business and marketing, nutrition and health, planning and design, consumer horticulture, and crop production information).
- **Assume leadership for urban and rural agriculture coalition building and for engaging various interest communities in urban agriculture planning, program development, and funding**. These joint coalitions could address regional opportunities for achieving a competitive advantage around unique urban-rural enterprises, cultural amenities, and alliances.
- **Enhance extension's human resource capacity by offering urban agriculture professional development opportunities involving specialized training from nontraditional partners and the campuswide community; identify opportunities for extension personnel to learn from, and work with, new urban agriculture partners and cooperators**.
- **Support and enhance volunteer-based programs** such as extension Master Gardeners and extension Master Composters, and expand the concept to include "master entrepreneurs" or other appropriate volunteer-based programs.

5. **Experiential learning.** ***An opportunity exists to engage K–12 education, undergraduate, and graduate students attending public and private schools, colleges, and universities, in the issues and problems of urban agriculture.*** Engagement can be facilitated through student experiential learning or service-learning opportunities such as internships, traineeships, and applied research projects. Through service-learning courses and community-based programs of study, students from different disciplines can collaborate with the private and public sectors and with nonprofit organizations to create meaningful community activities for academic credit. The service learning model, where institutionalized, can enrich the learning and discovery experiences of faculty, students, and members of both rural and urban agriculture communities. Specific suggestions for universities attempting to strengthen the experiential learning experience for students, faculty, and partners follow:
   - **A campuswide center or institute should be created to address the rural-urban agroecosystem**. A collaborative unit patterned after Clemson University's Sandhill Collaboration Center could bring together diverse college and extension expertise, environmental and sustainability interests, community leaders, and others. State agency partners might include commercial, natural resource, environmental, recreational, and tourist groups. University and other organizational investments would be necessary.
   - **University resources should be invested in a community of scholars program to support rural-urban agroecosystem experiential learning opportunities**.
   - **Partnerships should be encouraged between faculty in agricultural sciences and the social sciences to bring together in a service learning setting students of agriculture and those interested in urban and/or related human issues**. The intent would be to collaborate with urban professionals and to use agricultural applications to meet community needs.
6. **Funding strategies.** ***To finance or to support the building of partnerships and the urban agriculture agenda, creative funding strategies are needed.*** One of the major challenges to supporting urban agriculture initiatives will be the perception that funds will be diverted from

already underfunded rural commitments. This dilemma highlights the importance of a well-planned strategy evidencing clear understanding of the benefits to all partners. Funding resources must be identified and shared so that all partners benefit. Although redirection of resources may be one way to support new initiatives, revenue streams may be limited. Some alternative funding strategies are as follows:

- **Target state and federal grant initiatives to engage rural and urban people in planning processes that address the rural-urban agroecosystem**.
- **Form a rural-urban coalition of interests to identify and to respond to common rural concerns**.
- **Engage legislators, businesses, nonprofit organizations, government agencies, and community leaders in development of joint proposals**. A broad base of ownership in the proposal concept, its implementation, and problem solving approaches should be built (e.g., through think tanks, coalitions, centers, and/or institutes).
- **Approach private and nonprofit funding sources to support rural-urban agriculture partnership initiatives**.
- **Create innovative business models for profit- and resource-sharing** (e.g., of facilities, personnel, expertise, or funds) that involve private industry, local communities, family farmers, retailers, etc.
- **Develop fee-based university-delivered distance learning and professional development programs**.

Conclusions

Agriculture is an integral part of urban growth and population change. This fact often is unrecognized by the general public, mainstream agricultural interests, and political leaders. In the minds of many, there is sometimes a rural-urban split that results in competition for resources, separate policies, and inaccurate stereotypes. But the interests and goals of rural and urban areas must be addressed together, and agriculture may provide a framework in which to do this. Many people have a deep-seated cultural need, sometimes expressed in terms of the satisfaction of working in the soil, of being close to nature, of sharing time with a pet, or of knowing the farmers who produce their food. This document has attempted to paint a broad picture of agriculture beyond its traditional rural roots and production focus and to move the discussion towards viewing agriculture as a common denominator across rural and urban communities and environments. This CAST report has documented some of the many diverse components of agriculture that are embedded in the rural-urban agroecosystem, a holistic concept used to highlight the connections between rural and urban economic, environmental, and human factors (see Figure 1.1).

The objectives of this report have been (1) to broaden the understanding of agriculture in an urbanizing society; (2) to identify opportunities for rural and urban constituencies to work cooperatively toward common goals; (3) to document the contributions and/or services that agriculture provides to both rural and urban sectors; (4) to stimulate broad debate and discussions about program and policy directions and priorities pertaining to agriculture in an urbanizing society; and (5) to propose ways in which contemporary agriculture, with other partners, can help society meet the challenges associated with urbanization. The audience for the report has been government policymakers and planners; administrators and faculty of colleges and universities; and members of diverse agricultural interest groups. Although the contents are applicable to the interests of traditional agricultural clientele, such as agriculture commodity groups, they have direct relevance to the needs of local government decision makers and planners, and to urban-oriented organizations focused on problems of urban growth, economic development, community advocacy, food security, resource management, and other issues.

Several useful, though not necessarily new, concepts have been discussed: urban agriculture and the rural-urban agroecosystem. Terms such as *rural*, *urban*, *metropolitan*, and *farm* have been clarified. The document has provided background on the historical, political, geographical, and demographic context of agriculture, discussed the myths and stereotypes associated with agriculture, and documented the metropolitan nature of today's agriculture. For example, by 1997, metropolitan counties accounted for more than half of all agricultural employment.

The report has summarized the services provided by contemporary agriculture to both urban and rural areas, e.g., restoration and remediation, planning and revitalization, and modifying landscapes and conserving energy. Other benefits of agriculture, such as

business and economic contributions, individual and community health and well-being, and recreation and tourism, have been described. Growth management and agricultural land-use policy, including an overview of tools and strategies for agricultural land and open space protection, have been addressed. The concluding section has proposed important new visions to consider for agriculture in an urbanizing society. A number of different elements within each of the topics presented have received attention: comprehensive planning, higher education, research, and partnerships and collaboration.

This clearly is an appropriate time to redefine agriculture in the context of an urban society. The wealth of knowledge associated with the wide array of agricultural sciences could be put to valuable use in helping to meet many of the challenges of urbanization. Together, rural and urban communities have the potential to create a mutually beneficial situation based on their unique resources, experiences, and common needs. Success will be achieved, however, only with proactive leadership, shared resources, creative policy options, and effective collaboration. Land-grant universities, industry, traditional agricultural interest groups and urban partners—such as metropolitan educational institutions, city leaders, and urban planners—will need to work together to embrace change and provide a new and exciting future for everyone.

Appendix A: Tables

Table A.1. Historical patterns of size of farm population and percentage of U.S. population

Year	Farm population (000s)	Percentage of U.S. population
1880	21,973	43.8
1890	24,771	42.3
1900	29,875	39.2
1910	32,077	34.8
1920	31,974	30.2
1930	30,529	24.8
1940	30,547	23.1
1950	23,048	15.2
1959	16,592	9.4
1960	13,445	7.5
1964	12,954	6.8
1969	10,307	5.1
1970	9,712	4.8
1974[a]	9,264	4.4
1978	6,501	2.8
1980	6,051	2.7
1982	5,628	2.5
1987	4,986	2.1
1990	4,591	1.9
1991	4,632	1.8

[a]Subsequent data were based on 1974 *farm* definition.

Source: Data from 1880 to 1910 from USDC (1975). Data for 1920 to 1980 from Kalbacher and DeAre (1986). Other data from USBC (1993b).

Table A.2. Historical patterns of number of farms, acres in farms, percentage of land in farms, and average size of farms, 1850 to 1997

Year	Number of farms (000s)	Acres in farms (000s)	Percentage of land in farms	Average farm size (acres)
1850	1,449	293,561	15.6	203
1860	2,044	407,213	21.4	199
1870	2,660	407,735	21.4	153
1880	4,009	536,082	28.2	134
1890	4,565	623,219	32.7	137
1900[a]	5,740	841,202	37.0	147
1910	6,366	881,431	38.8	139
1920	6,454	958,677	42.2	149
1930	6,295	990,112	43.6	157
1940	6,102	1,065,114	46.8	175
1950	5,388	1,161,420	51.1	216
1954	4,782	1,158,191	60.8	242
1959	3,711	1,123,508	49.5	303
1964	3,158	1,110,185	49.0	352
1969	2,730	1,063,346	47.0	389
1974[b]	2,314	1,017,030	44.8	440
1978	2,258	1,014,777	44.6	449
1982	2,241	986,797	43.6	440
1987	2,088	964,471	42.6	462
1992	1,925	945,532	41.8	491
1997	1,912	931,795	42.2	487

[a]Data for Alaska and Hawaii were included for the first time.

[b]Subsequent data were based on 1974 *farm* definition.

Source: Data from 1850 to 1969 from USDC (1975). Post-1970 data from the periodic *Census of Agriculture* conducted by the USDC and the USBC.

Table A.3. Population by ethnicity, 1980 to 1999, and county metropolitan proximity in 1993[a]

County metro proximity, 1993	Number of counties		Anglos	Blacks	Other races	Hispanics
1980						
Metro	836	Sum	137,415,038	21,908,489	4,575,446	13,111,049
		% of total sum	76.2	83.9	82.1	89.8
Adjacent to metro	1,002	Sum	23,204,536	2,537,159	326,702	799,981
		% of total sum	12.9	9.7	5.9	5.5
Not adjacent to metro	1,297	Sum	19,631,186	1,658,196	667,683	697,322
		% of total sum	10.9	6.4	12.0	4.8
Total	3,133	Sum	180,250,760	26,103,844	5,569,831	14,608,352
		% of total sum	100.0	100.0	100.0	100.0
1990						
Metro	836	Sum	145,031,516	24,955,181	7,789,538	20,035,736
		% of total sum	77.0	85.2	85.6	91.5
Adjacent to metro	1,003	Sum	23,964,065	2,630,250	465,160	1,027,809
		% of total sum	12.7	9.0	5.1	4.7
Not adjacent to metro	1,299	Sum	19,422,985	1,698,519	843,607	835,847
		% of total sum	10.3	5.8	9.3	3.8
Total	3,138	Sum	188,418,566	29,283,950	9,098,305	21,899,392
		% of total sum	100.0	100.0	100.0	100.0
1999						
Metro	835	Sum	150,013,778	27,714,914	10,631,390	27,375,424
		% of total sum	76.7	84.7	87.3	91.0
Adjacent to metro	1,002	Sum	25,486,249	3,075,353	551,889	1,538,256
		% of total sum	13.0	9.4	4.5	5.1
Not adjacent to metro	1,298	Sum	20,042,613	1,912,045	989,700	1,173,455
		% of total sum	10.2	5.8	8.1	3.9
Total	3,135	Sum	195,542,640	32,702,312	12,172,979	30,087,135
		% of total sum	100.0	100.0	100.0	100.0

[a]Source: U.S. Bureau of the Census (1993a) and authors' computations. Race and ethnicity data in the 2000 census were excluded because changes in definitions affected their comparability with data from prior years.

Table A.4. County population change, 1980 to 1999, by ethnicity and metropolitan proximity in 1993[a]

County metro proximity, 1993		Percentage of change in population							
		Anglos		Blacks		Hispanics		Other populations	
		1980 to 1990	1990 to 1999	1980 to 1990	1990 to 1999	1980 to 1990	1990 to 1999	1980 to 1990	1990 to 1999
Metro	Mean	12.0	9.5	36.4	42.7	42.5	93.8	79.8	46.6
	Median	7.1	6.4	14.8	24.1	34.8	71.8	61.2	39.4
	Number	836	836	836	836	836	836	836	836
Adjacent to metro	Mean	2.7	5.5	67.6	136.8	16.9	120.7	66.9	39.6
	Median	0.5	3.8	1.0	18.8	5.4	72.6	39.8	20.1
	Number	1,003	1,002	1,003	1,003	1,002	1,003	1,003	1,003
Not adjacent to metro	Mean	–3.2	0.9	103.0	82.1	18.7	117.3	40.8	45.5
	Median	–5.2	–0.4	0.0	10.0	3.3	63.1	20.6	15.0
	Number	1,299	1,299	1,299	1,299	1,299	1,299	1,292	1,268
Total	Mean	2.8	4.7	74.0	89.1	24.5	112.1	59.5	43.9
	Median	–0.3	2.4	3.1	17.7	13.1	69.3	37.3	24.3
	Number	3,138	3,138	3,138	3,138	3,138	3,138	3,138	3,138

[a]Source: U.S. Bureau of the Census and authors' computations. Race and ethnicity data in the 2000 census were excluded because changes in definitions affected their comparability with data from prior years.

Table A.5. Employment in the agricultural, forestry, and fisheries industry, 1980 to 1997, by county metropolitan proximity in 1993[a]

County metro proximity, 1993		1980[b]	1990[c]	1997[c]
Metro	Employment	1,840,802	1,680,307	1,651,319
	% of ag industry employment	46.9	53.9	54.5
	% of category's total employment[d]	2.4	1.8	1.6
	% of total U.S. employment[e]	1.9	1.5	1.3
Adjacent to metro	Employment	971,619	715,788	695,720
	% of ag industry employment	24.8	23.0	22.9
	% of category's total employment[d]	9.2	6.0	5.4
	% of total U.S. employment[e]	1.0	0.6	0.6
Not adjacent to metro	Employment	1,108,124	719,064	685,476
	% of ag industry employment	28.3	23.0	22.6
	% of category's total employment[d]	12.8	7.6	6.8
	% of total U.S. employment[e]	1.1	0.6	0.5
Total	Employment	3,920,786	3,115,159	3,032,515
	% of ag industry employment	100.0	100.0	100.0
	% of total U.S. employment[e]	4.0	2.7	2.4

[a]Source: U.S. Bureau of the Census (1993a) and authors' computations. Wessex, Inc. provided 1997 employment estimates. *Agricultural industries* included crop production; livestock production; agricultural services (except horticulture); horticultural services; forestry; and fishing, hunting, and trapping.

[b]Includes mining employment for 1980 only. Also, three unclassified counties had 241 workers in the agriculture, forestry, and fisheries industry and 2,649 workers in all industries in 1980.

[c]Two unclassified counties had no workers in the agriculture, forestry, and fisheries industry but had 80 and 58 workers in other industries during 1990 and 1997, respectively.

[d]Percentage sector employment was based on the employment in all industries for the particular metropolitan/nonmetropolitan category.

[e]Percentage U.S. employment was based on the total employment across all industries in the United States for the indicated year.

Table A.6. Employment in agricultural (farming, forestry, and fishing) occupations, 1980 to 1997, by county metropolitan proximity in 1993[a]

County metro proximity, 1993		1980[b]	1990[c]	1997[c]
Metro	Employment	1,281,871	1,508,141	1,583,441
	% of ag occupation employment	45.9	53.1	53.6
	% of category's total employment[d]	1.6	1.6	1.6
	% of total U.S. employment[e]	1.3	1.3	1.2
Adjacent to metro	Employment	745,904	666,604	694,393
	% of ag occupation employment	26.7	23.5	23.5
	% of category's total employment[d]	7.1	5.2	5.4
	% of total U.S. employment[e]	0.8	0.5	0.6
Not adjacent to metro	Employment	766,261	664,122	678,350
	% of ag occupation employment	27.4	23.4	22.9
	% of category's total employment[d]	8.9	7.0	6.8
	% of total U.S. employment[e]	0.8	0.6	0.5
Total	Employment	2,794,213	2,838,873	2,956,187
	% of ag occupation employment	100.0	100.0	100.0
	% of total U.S. employment[e]	2.9	2.4	2.4

[a]Source: U.S. Bureau of the Census (1993a) and authors' computations. Wessex, Inc. provided 1997 employment estimates. *Agricultural occupations* included farming, forestry, and fishing jobs, as well as horticultural specialty farmers and managers.

[b]Three unclassified counties had 177 workers in agricultural occupations and 2,649 workers in all occupations in 1980.

[c]Two unclassified counties had 6 agricultural workers and 80 workers in other occupations during 1990. In 1997, unclassified counties had 3 agricultural workers and 54 workers in other occupations.

[d]Percentage sector employment was based on the employment in all industries for the particular metropolitan/nonmetropolitan category.

[e]Percentage U.S. employment was based on the total employment across all industries in the United States for the indicated year.

Table A.7. Total number of farms, 1978 to 1997, by metropolitan proximity in 1993[a]

County metro proximity, 1993		Total number of farms				
		1978	1982	1987	1992	1997
Metro	Mean[b]	889	911	858	777	772
	Median[c]	777	789	733	662	639
	Number[d]	800	804	793	801	802
Adjacent to metro	Mean	787	772	715	663	650
	Median	701	684	636	594	581
	Number	981	982	984	983	982
Not adjacent to metro	Mean	608	590	559	513	507
	Median	530	518	482	446	439
	Number	1,271	1,272	1,255	1,265	1,267
Total	Mean	739	733	688	613	526
	Median	637	621	580	526	524
	Number	3,052	3,058	3,032	3,049	3,051

[a]Source: U.S. Bureau of the Census (1978 to 1992) and USDA–NASS (1997a).

[b]*Mean* is equal to the total number of farms divided by the number of counties in a proximity group.

[c]*Median* is the number of farms whereby one-half of the counties are ranked below and one-half above that number.

[d]*Number* is the number of counties that had farms. Some counties were omitted because of missing information or lack of farms.

Table A.8. Percentage of county acres in farmland, 1978 to 1997, by metropolitan proximity in 1993[a]

County metro proximity, 1993		Percentage of acres in farmland				
		1978	1982	1987	1992	1997
Metro	Mean[b]	41.1	39.3	37.6	36.2	35.5
	Median[c]	43.6	42.0	40.0	37.0	37.2
	Number[d]	800	804	793	801	802
Adjacent to metro	Mean	54.4	53.2	51.8	50.7	49.7
	Median	58.8	57.0	54.0	52.0	52.2
	Number	981	982	984	983	982
Not adjacent to metro	Mean	42.5	41.6	41.2	40.5	39.8
	Median	68.8	67.0	66.0	65.0	64.1
	Number	1,271	1,272	1,255	1,265	1,267
Total	Mean	44.9	43.7	42.9	41.9	41.1
	Median	56.2	55.0	53.0	50.0	49.4
	Number	3,052	3,058	3,032	3,049	3,051

[a]Source: U.S. Bureau of the Census (1978 to 1992) and USDA–NASS (1997a).

[b]*Mean* percentage equals 100 times the sum of the number of farm acres in a proximity group divided by the total number of county-land acres in that group of counties.

[c]*Median* is the middle percentage value in the ranking of farmland percentages for counties in a proximity group.

[d]*Number* is the number of counties in the proximity group. Some counties were omitted because of missing information or lack of farms.

Table A.9. Average farm size in acres, 1978 to 1997, by metropolitan proximity in 1993[a]

County metro proximity, 1993		Average farm size in acres				
		1978	1982	1987	1992	1997
Metro	Mean[b]	276	257	262	274	271
	Median[c]	195	185	188	191	189
	Number[d]	800	804	793	801	802
Adjacent to metro	Mean	360	358	379	399	392
	Median	255	254	264	274	277
	Number	981	982	984	983	982
Not adjacent to metro	Mean	696	701	739	790	777
	Median	351	360	388	412	426
	Number	1,271	1,272	1,255	1,265	1,267
Total	Mean	449	440	462	491	487
	Median	266	262	273	283	285
	Number	3,052	3,058	3,032	3,049	3,051

[a]Source: U.S. Bureau of the Census (1978 to 1992) and USDA–NASS (1997a).

[b]*Mean* equals the sum of the number of farm acres divided by the total number of farms in a proximity group of counties.

[c]*Median* is the middle value in the ranking of average farm sizes for counties in a proximity group.

[d]*Number* is the number of counties in the proximity group. Some counties were omitted because of missing information or lack of farms.

Table A.10. Total gross sales ($000s) for farms, 1978 to 1997, by metropolitan proximity in 1993[a]

County metro proximity, 1993		Total gross value of agriculture product sales ($000s)				
		1978	1982	1987	1992	1997
Metro	Mean[b]	49,921	60,693	68,307	87,354	107,725
	Median[c]	33,489	40,094	44,191	54,729	63,812
	Number[d]	800	804	793	801	802
Adjacent to metro	Mean	41,737	52,414	57,609	73,913	89,247
	Median	33,954	42,549	47,906	60,883	71,025
	Number	981	982	984	983	982
Not adjacent to metro	Mean	50,792	63,579	69,834	92,230	112,181
	Median	40,698	49,176	54,371	67,178	77,243
	Number	1,271	1,272	1,255	1,265	1,267
Total	Mean	47,419	58,860	65,213	84,442	102,954
	Median	36,449	44,645	49,036	61,190	71,699
	Number	3,052	3,058	3,032	3,049	3,051

[a]Source: U.S. Bureau of the Census (1978 to 1992) and USDA–NASS (1997a).

[b]*Mean* equals the sum of gross farm acres divided by the total number of farms in a proximity group of counties.

[c]*Median* is the middle value in the ranking of average gross farm sales for counties in a proximity group.

[d]*Number* is the number of counties in the proximity group. Some counties were omitted because of missing information or lack of farms' sales.

Table A.11. Value of crop sales ($000s) for farms, 1978 to 1997, by metropolitan proximity in 1993[a]

Crops by metro proximity, 1993	Crop sales ($000s)				
	1978	1982	1987	1992	1997
Metro					
Grains	6,327,721	8,330,507	6,235,848	7,862,408	9,968,343
Cotton/cottonseed	1,207,605	1,422,270	1,569,898	1,576,294	1,791,667
Tobacco	849,340	999,508	616,426	929,894	1,064,216
Hay/silage/field seeds	751,060	766,714	884,780	1,074,747	1,644,105
Vegetables/corn/melons	2,437,525	3,164,869	3,437,311	4,712,288	6,088,115
Fruits/nuts/berries	3,521,503	4,531,478	5,324,461	6,817,748	9,851,590
Nursery/greenhouse	2,213,408	3,008,152	4,497,098	5,840,527	8,310,164
Other crops	1,076,344	1,277,912	1,638,225	1,801,094	1,788,801
Total	18,384,506	23,501,410	24,204,047	30,615,000	40,507,002
Adjacent to metro					
Grains	8,949,495	11,933,104	9,277,339	11,791,942	15,127,788
Cotton/cottonseed	927,545	892,914	1,309,347	1,416,259	2,026,035
Tobacco	996,310	1,165,848	740,266	1,129,669	1,243,838
Hay/silage/field seeds	640,139	640,241	761,911	907,331	1,262,123
Vegetables/corn/melons	505,121	615,829	788,379	972,235	1,372,163
Fruits/nuts/berries	599,615	727,721	1,010,458	1,403,605	1,694,315
Nursery/greenhouse	181,872	240,845	480,777	741,782	1,206,341
Other crops	777,175	945,333	1,133,126	1,538,650	1,585,067
Total	13,577,272	17,161,835	15,501,603	19,901,473	25,517,670
Not adjacent to metro					
Grains	11,382,310	15,759,968	12,802,120	16,204,505	21,392,406
Cotton/cottonseed	952,956	878,166	1,279,970	1,501,054	2,061,101
Tobacco	465,200	584,685	364,495	585,337	595,269
Hay/silage/field seeds	760,462	756,274	807,450	1,028,739	1,570,492
Vegetables/corn/melons	216,329	264,802	381,685	561,621	713,218
Fruits/nuts/berries	369,132	466,657	534,830	852,662	906,015
Nursery/greenhouse	98,822	138,666	180,990	375,776	570,287
Other crops	1,093,299	1,385,183	1,568,338	1,944,345	2,171,371
Total	15,338,510	20,234,401	17,919,878	23,054,039	29,980,159
Total					
Grains	26,659,526	36,023,579	28,315,307	35,858,855	46,488,537
Cotton/cottonseed	3,088,106	3,193,350	4,159,215	4,493,607	5,878,803
Tobacco	2,310,850	2,750,041	1,721,187	2,644,900	2,903,323
Hay/silage/field seeds	2,151,661	2,163,229	2,454,141	3,010,817	4,476,720
Vegetables/corn/melons	3,158,975	4,045,500	4,607,375	6,246,144	8,173,496
Fruits/nuts/berries	4,490,250	5,725,856	6,869,749	9,074,015	12,451,920
Nursery/greenhouse	2,494,102	3,387,663	5,158,865	6,958,085	10,086,792
Other crops	2,946,818	3,608,428	4,339,689	5,284,089	5,545,240
Total	47,300,288	60,897,646	57,625,528	73,570,512	96,004,831

[a]Source: U.S. Bureau of the Census (1978 to 1992) and USDA–NASS (1997a).

Table A.12. Value of livestock and poultry sales ($000s) for farms, 1978 to 1997, by metropolitan proximity in 1993[a]

Livestock and poultry by metro proximity, 1993	Livestock and poultry sales ($000s)				
	1978	1982	1987	1992	1997
Metro					
Poultry/products	2,973,704	3,347,482	4,226,327	4,530,091	5,663,362
Dairy products	4,837,784	6,964,751	6,972,242	7,795,346	8,533,442
Cattle/calves	6,502,374	6,685,158	7,047,534	7,286,179	6,824,449
Hogs/pigs	1,484,688	1,997,807	1,989,621	1,875,890	2,141,777
Sheep/lambs/wool	160,064	150,815	199,129	205,796	221,016
Other livestock/products	457,168	707,770	895,292	795,244	1,163,754
Total	16,415,782	19,853,783	21,330,145	22,488,546	24,547,800
Adjacent to metro					
Poultry/products	2,915,251	3,339,316	4,485,218	5,701,422	8,673,118
Dairy products	4,030,462	5,876,470	5,869,493	6,414,831	6,415,695
Cattle/calves	7,880,658	8,471,271	9,631,307	10,517,116	9,721,171
Hogs/pigs	2,798,823	3,594,061	3,629,611	3,854,694	5,130,557
Sheep/lambs/wool	129,964	112,129	164,052	124,512	127,621
Other livestock/products	124,603	163,878	253,550	268,365	364,669
Total	17,879,761	21,557,125	24,033,231	26,880,940	30,432,831
Not adjacent to metro					
Poultry/products	2,050,516	2,295,404	3,049,166	4,027,639	5,932,337
Dairy products	2,076,947	2,941,833	2,977,602	3,299,703	3,693,219
Cattle/calves	15,021,907	15,909,772	19,068,311	23,169,932	23,457,653
Hogs/pigs	3,307,251	4,182,212	4,131,963	4,155,343	5,595,427
Sheep/lambs/wool	298,934	252,151	344,244	259,083	272,565
Other livestock/products	143,668	173,382	324,627	345,784	489,724
Total	22,899,223	25,754,754	29,895,913	35,257,484	39,440,925
Total					
Poultry/products	7,939,471	8,982,202	11,760,711	14,259,152	20,268,817
Dairy products	10,945,193	15,783,054	15,819,337	17,509,880	18,642,356
Cattle/calves	29,404,939	31,066,201	35,747,152	40,973,227	40,003,273
Hogs/pigs	7,590,762	9,774,080	9,751,195	9,885,927	12,867,761
Sheep/lambs/wool	588,962	515,095	707,425	589,391	621,202
Other livestock/products	725,439	1,045,030	1,473,469	1,409,393	2,018,147
Total	57,194,766	67,165,662	75,259,289	84,626,970	94,421,556

[a]Source: U.S. Bureau of the Census (1978 to 1992) and USDA–NASS (1997a).

Table A.13. Locations and total production areas of the top five floricultural producers in the United States (Onofrey 2000)

Company	Headquarters location	Examples of production locations	Total production area (millions of square feet)	Crop mix
Hines Horticulture	Irvine, CA (Los Angeles area)	Vacaville, CA (between Sacramento and San Francisco); Houston, TX	12.0	50% bedding plants 50% potted flowering plants
Color Spot Nurseries, Inc.	Pleasant Hill, CA (San Francisco Bay Area)	San Francisco Bay Area, CA; San Antonio, TX	11.9	36% bedding plants 31% potted flowering plants 18% foliage plants 15% other
Kurt Weiss Greenhouses	Long Island, NY	Cheshire, CT; Long Island, NY; Georgetown, SC (about 60 miles from Charleston)	7.0	75% potted flowering plants 20% bedding plants 5% other
Yoder Brothers	Barberton, OH (near Cleveland/Akron)	Salinas, CA; Fort Myers, FL; Pendleton, SC (near Greenville)	4.6	89% propagation material 9% potted flowering plants 2% other
Baucom's	Summerville, SC (near Charleston)	Summerville, SC	3.8	30% bedding plants 30% potted flowering plants 20% foliage plants 20% other

Table A.14. Top ten U.S. lawn and garden retail businesses in 1999 (Morey, Morey, and Morey 2000)

Company	Sales ($ million)	Number of stores
Home Depot	5,490	900
Lowe's, Inc.	2,780	556
Wal-Mart, Inc.	1,317	2,485
K-Mart Corp.	1,262	2,167
Orchard Supply Hardware/Sears	578	200
Frank's Nursery and Crafts	500	257
Target, Inc.	376	674
Menard's Inc.	310	150
Price Costco Co.	275	195
Albertson's Inc.	230	1,700

Appendix B: Abbreviations, Acronyms, and Symbols

a.	acre
ACGA	American Community Gardening Association
AFT	American Farmland Trust
AHTA	American Horticultural Therapy Association
AMS	Agricultural Marketing Service
APZ	agricultural protection zoning
CCC	Commodity Credit Corporation
CO_2	carbon dioxide
CRP	conservation reserve program
CSA	community supported agriculture
CSREES	Cooperative State Research, Education, and Extension Service
DOE	Department of Education
EPA	Environmental Protection Agency
ERS	Economic Research Service
FAO	Food and Agriculture Organization
FDA	Food and Drug Administration
FFA	Future Farmers of America
FPC	Food policy council
FPP	Farmland Protection Program
FTE	full time equivalent
gal.	gallon
HFS	Hartford Food System
hr	hour
HT	horticultural therapy
IPM	integrated pest management
kWh	kilowatt hour
lb	pound
LGU	land grant university
MA	metropolitan area
MG	master gardener
MIA	Miami International Airport
MLRA	major land resource area
MSA	metropolitan statistical area
Mt	million metric tons
NASS	National Agricultural Statistics Service
NIH	National Institutes of Health
NRCS	Natural Resources Conservation Service
NRI	*National Resources Inventory*
NSF	National Science Foundation
NTUFHP	NonTimber urban forestry and horticultural product
OMB	Office of Management and Budget
PDR	purchase of development rights
ppm	part per million
SMA	standard metropolitan area
SMSA	standard metropolitan statistical area
sq ft	square feet
t	ton
TDR	transfer of development rights
TMDL	total maximum daily load
URP	Urban Resource Partnership
USD	U.S. dollars
USDA	U.S. Department of Agriculture
WIC	Women, Infants, and Children
WRI	World Resources Institute

Appendix C: Glossary

Adaptive farms. Farms with sales of $10,000 or more annually, on which high-value products make up one-third of sales, more than $500 in sales is earned per acre, there are100 to 200 acres requiring intensive labor and input management, and the farm operates as a business exclusively or with other enterprises.

Agricultural districts. Legally recognized geographic areas designed to keep land in agriculture. Formed by one or more landowners and approved by one ore more government agencies, they are created for fixed, renewable terms.

Agricultural protection zoning. Ordinances protecting the agricultural land base by limiting nonfarm uses, prohibiting high-density development, requiring houses to be built on small lots, and restricting subdivision of land into parcels that are too small to farm.

Atmospheric carbon dioxide. A greenhouse gas crucial to maintaining a heat balance on earth. Carbon dioxide is the most important atmospheric heat-trapping gas.

Bioremediation. Use of microbes to break down or to immobilize toxic compounds.

Brownfields. Abandoned, idled, or under-used industrial or commercial sites where real or perceived environmental contamination has occurred.

Carbon cycle. One of the central processes in the ecosystem, by which carbon is transferred between organisms, soils, and the atmosphere.

Carbon cycling process. The role of soil respiration and structure, contributions from plants and microorganisms, and the rates of carbon transfer between active and resistant fractions of stored carbon.

Carbon sequestration. Removal and storage of carbon dioxide in above- and below- ground biomass. Storage of carbon dioxide can help to mitigate global temperature change and to improve soil quality.

Community food system. A local or regional food system with four specific qualities: (1) concern for food security; (2) relatively short distances between system components, as between producer and consumer; (3) self reliance; (4) sustainability.

Community health. The socio-economic capacity of a community to create a social and physical environment to sustain the visions and goals of the citizens.

Constructed wetlands. Human-created wetlands designed and developed for water treatment.

Disturbed lands. Mine sites, highways, rights-of-way, etc.

Environmental horticulture. Also called ornamental horticulture; the cultivation of indoor and outdoor landscape plants for use in populated environments.

Food policy council. An officially sanctioned group of people representing different elements of a state or local food system and charged with such things as making recommendations for the improvement of the food system, educating the public about their food system, etc; roles of food policy councils may vary.

Food system. All the steps involved in putting food on the table: growing, harvesting, processing, packaging, transporting, marketing, consuming, and disposing.

Green industry. Enterprises engaging in the commerce of environmental horticulture, e.g., nurseries, greenhouses, sod farms, and landscape maintenance firms.

Impermanence syndrome. A process of disinvestment in farming or a reduction of the intensity of farm production in anticipation of future land-use conversion.

Living machines. A technology attempting to convert high-strength industrial wastewater into a water supply suitable for most home needs.

Modern (or contemporary) agriculture. Modern agriculture consists of five major components: (1) It includes the development and manufacture of biotechnologies, agrichemicals, mechanical equipment, and other technologies that enhance production capabilities, increase product safety, and improve product quality for consumers; (2) it includes conservation and preservation enterprises aimed at sustaining and remediating natural resources, and promoting eco-recreation and agritourism; (3) it includes creating and effectively managing functional, attractive landscapes that enhance the urban environment and make cities more livable; (4) it involves the producing, gathering, processing, and marketing of food, fiber, ornamental plants, and forest products for consumers; and (5) it embraces the activities of people and organizations that produce, disseminate, and/or use agriculturally related information for decision-making purposes and for public education. *See also* urban agriculture.

Phytoremediation. Use of plants to accumulate contaminates and/or to break down waste (toxins) into less harmful products.

Purchase of agricultural conservation easements (PACE). Programs that pay farmers to keep their land available for ag-

riculture. Landowners sell an agricultural conservation easement to a qualified public agency or private conservation organization. *See also* purchase of development rights (PDR).

Purchase of development rights (PDR). A community growth management strategy intended to provide increased protection for farmland, forest, and natural areas by removing development potential from land areas placed in a protected status. *See also* purchase of agricultural conservations easements (PACE).

Recreational farms. Farms with sales of less than $10,000 annually, having less than 100 acres, and requiring little daily management.

Right-to-farm laws. Laws protecting farmers and farm operations from both public and private nuisance lawsuits. A private nuisance interferes with an individual's use and enjoyment of his or her property. A public nuisance involves actions that injure the public at large.

Rural-urban agroecosystem. A biological and natural resources system managed jointly by rural and urban people (1) to provide services to the environment and community, (2) to generate direct and indirect business (including food production and marketing) and health benefits for society as a whole, and (3) to contribute recreation and leisure outlets for an urbanizing society (See Figures 1.1 and 1.3 in Chapter 1.)

Self-sufficiency index. Percentage of total program expenses covered by sales.

Smart growth strategies. Strategies used by planners to influence the pattern and density of human population development.

Sprawl. Inflation that occurs over time in the amount of land area consumed per unit of human activity, and the degree of dispersal between land areas; the unavoidable consequence of society's use of automobiles. Anthony Downs, policy analyst, identified the following ten traits of sprawl: unlimited outward expansion; low-density residential and commercial settlements; leapfrog development; fragmentation of powers over land use among many small localities; dominance of transportation by private vehicles; no planning or control of land uses; widespread strip commercial development; great fiscal disparities among localities; segregation of types of land uses in different zones; and reliance on trickle-down to provide housing to low-income households. (Sprawl Guide, http://www.plannersweb.com/sprawl/define.html [28 April 2001])

Traditional farms. Farms with sales of more than $10,000 annually, high-value products making up one-third or less of sales with $500 or less sales/acres, or conventional livestock and/or crops that make up more than one-third of sales, more than 200 acres (the largest of the three types of farms), little off-farm employment, and extensive management rather than intensive management.

Traffic calming. A technique by which landscaped circles and speed control mechanisms slow traffic and reclaim streets for pedestrians and neighborhoods.

Transfer of development rights (TDR). A program allowing landowners to transfer the right to develop one parcel of land to a different parcel of land to prevent farmland conversion. TDR programs establish "sending areas" where land is to be protected by agricultural conservation easements and "receiving areas" where land may be developed at a higher density than otherwise would be allowed by local zoning.

Urban agriculture. A complex system encompassing a full spectrum of activities from a traditional core of production, processing, marketing, distribution and consumption, to more extensive system components including recreation and leisure, business entrepreneurship, individual health benefits, scenic beautification, environmental restoration and remediation, community health and well-being services, and economic vitality. *See also* modern (or contemporary) agriculture.

Urban-influenced. Areas within statistical metropolitan counties or adjacent counties.

Water re-use. Reclamation, or “gray,” water from waste treatment facilities that is used to sustain recreational areas and irrigation of nonfood crops.

Zoning law. Division of land within a jurisdictional area into various districts so that land is used for consistent, compatible purposes.

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