Public Health Implications of Urban Agriculture

KATE H. BROWN and ANDREW L. JAMETON

THE idea of urban agriculture may seem counterintuitive to generations who have grown up in the United States thinking of farming as an exclusively rural endeavor. However, millions of people worldwide are dependent on crops and animals raised in cities. Faced with enormous urban population growth and economic and political changes that increasingly undermine local food distribution systems, many cities around the world have begun to foster a range of experiments in urban agriculture. A 1996 United Nations report estimates that up to 80% of families in some Asian cities are involved in agriculture. The report notes that similarly high rates of participation are also found in Moscow, and in such African cities as Dar es Salaam, Kinshasa, Kampala, and Maputo (1). Havana, Cuba has also seen a remarkable shift towards urban agriculture with the collapse of its major food supplier, the Soviet Union, and the tightening of the United States' embargo (2).

Although not nearly on the scale of these international examples, there are numerous urban agricultural endeavors in the United States, and increasingly health professionals, urban planners, environmental activists, community organizers, and policy makers are recognizing the value of urban agriculture for economic development, food security, and preservation of green space. A 1991 report estimated that 33% (696,000) of the 2 million farms in the United States are located within metropolitan areas. These farms produce 35% of all crops and livestock sales (3). The United Nations document on urban agriculture reported that 25% of urban households in the United States are involved in gardening, including food gardens and landscaping (4). Although lawn care remains the most prevalent form of gardening nationwide, in 1995 nearly 50 million gardeners, many of them in

urban areas, grew vegetables. This number marks an increase of 10 million from 1992 (5). Urban agriculture in the United States produces an estimated $38 million worth of food annually (6).

In this article we examine trends in urban agriculture in the United States with a particular focus on the public health potential and pitfalls of urban agriculture. We explore the role of urban agriculture for nutritional health and food security, personal wellness and community betterment, and environmental health. And we suggest policy changes that could favorably advance the potential of urban agriculture for public health benefits in these areas.

URBAN AGRICULTURE

"Urban agriculture" refers to a wide range of agricultural ventures within city limits. Under this rubric in the United States fall such diverse efforts as *community gardens* where typically a lot is divided among households who tend small plots of land for their own use; *school gardens* where gardening on a school lot is incorporated into the curriculum; and intensive *entrepreneurial gardens* where vegetables, herbs, flowers, and animals are raised for wholesale and retail marketing. Because of existing regulations in the United States, urban agriculture is mostly limited to gardening endeavors and related industries; rarely does it include raising and processing livestock or fish as is often the case internationally.

Some urban agriculture takes place in the United States on a large, even industrial, scale, while other efforts consist of pocket gardens tucked into overlooked corners of the city. Urban agriculture also encompasses backyard, windowsill, and rooftop gardens. Many urban gardens are located on land that has been vacant or unused because it is otherwise unattractive for urban development. The typical pattern of urban sprawl has created an abundance of empty inner-city lots. Ironically, as new suburban housing and business developments overtake rural farmlands at the city's periphery, land in the inner-city becomes available when failed inner-city businesses and decaying homes are bulldozed. This is the case in the authors' home, Omaha, Nebraska, for example, where an inner-city area of five square miles contains over 3,000 vacant lots while many acres of outlying farmland are lost annually to new housing and business.

Land for urban gardens is often leased or even loaned free of charge by a city government or an individual property owner. Of the

6,020 community gardens reported in a 1998 national survey, for example, only 5.3% are owned (131) or in a land trust (187). This tenuous pattern of land tenancy has created problems for gardeners when their land is sold by its owners for other purposes (7). Despite an outpouring of popular concern (8), in 1999 over 100 of the 700 community gardens in New York City were placed at risk of being sold for new housing or commercial development. Some of these gardens have been in operation for 20 years. Only intensive community resistance and significant investments by land trusts and individuals have been able to save these gardens (9).

LEGISLATIVE SUPPORT FOR URBAN AGRICULTURE

The current interest in urban gardening in the United States echoes earlier trends, notably the Victory Garden movement during World War II. Victory Gardens were household vegetable gardens encouraged by government and citizens' groups as a way for civilians to support the war effort. Home-grown vegetables from Victory Gardens helped to stretch household budgets and reduce reliance on resources that could be otherwise used for the military. Some households sold their produce and donated the proceeds for war relief. Victory Gardens were more than a symbolic gesture toward domestic food security. In 1944, 20 million gardeners grew 40% of the nation's fresh vegetables (10).

Urban gardens again drew the attention of policy makers in the 1970s when large numbers of urbanites, pulled by the new ecology movement and pushed by inflationary food prices, once more turned to gardening. For some, gardens signaled a rebirth of concern for safeguarding the natural environment. Like their counterparts who settled in rural areas to experiment with "living off the land," many young urban gardeners saw their efforts as a means of raising consciousness about environmental stewardship. Others looked to urban gardens as a community organizing tool to combat poverty and provide a collective response to blighted city neighborhoods. Also, home-grown produce could offset the cost of purchasing food which, at that time, was highly inflated.

This ground-swell of interest in gardening as a cost-effective strategy to combat inflation was reflected in a 1975 subcommittee hearing of the House of Representatives. The legislation under discussion would have authorized the distribution of seeds and plants for use in

home gardens. Testifying at the hearing, Representative George Brown from California cited the 45% increase in the price of food since 1972 as a significant reason for the government to encourage some degree of self-sufficiency through home gardens (11). Representative Charles Carney from Ohio also spoke in support for what he termed "inflation gardens" (12). Representative James Burke from Massachusetts stated that,

> The average gardener can produce $240 worth of food for no more than an outlay of $9. In the past year, home gardeners of the Washington DC metropolitan area produced over $1 million worth of food that would not otherwise have existed. (13)

Despite Congressman Burke's claim that government support in this form would not hurt agribusiness, the legislation lacked the backing of the Department of Agriculture and was defeated under the influence of a coalition of seed companies and others in agribusiness.

In 1977, however, legislative support for gardening was successful. Congress allocated $1.5 million for the Urban Gardening Program to promote community gardens in 6 cities across the country by providing annual grants of $150,000 to $250,000 through the Cooperative Extension Service. The program was expanded to $3.6 million for 23 cities by 1993. Despite the program's popularity and success, direct funding for the Urban Gardening Program was discontinued eventually because of the loss of the program's champions in the House and its lack of support within the USDA and the Cooperative Extension Service (14).

Current funding for urban agriculture in the United States comes from a variety of government, business, and philanthropic sources. Funds still filter from USDA through the Cooperative Extension for some urban garden projects. Funding for urban gardening ventures is also sometimes available in grants and loans through Health and Human Services Community Development block grants. Other gardens are funded by entrepreneurs with bank loans and capital. Foundation and private donations largely support the nonprofit community agencies that are fostering gardening as a community development tool. In 1997, the federal government funded the Community Food Security Act through the USDA. This legislation provides grants to nonprofit agencies for regional models to enhance food security in poor communities. Some of the groups supported

through this program have promoted urban gardening as one component of a community-wide response to hunger (15).

FOOD SECURITY

The problem of matching food supplies to food needs, especially for urban populations, has long been a source of social, economic, and political concern. Archeologists attribute the fall of some ancient urban civilizations to the simple lack of food. Malthus, a Protestant minister and social theorist writing in the early days of Europe's industrial revolution, cautioned his contemporaries of such an eventuality. Hunger, he predicted, would always be a destabilizing factor because, by his calculations, populations tend to grow exponentially, a rate that easily exceeds the usual linear rate of growth in food production.

Are we on the verge of a Malthusian disaster today? Observing that the number of people living in cities is expected to triple by 2025, attendees of the Second United Nations Conference on Human Settlement (Habitat II) asked, "Where will the megatonnage of food come from to feed some five billion urban people?" (16). There are good reasons to doubt the long-term viability of the technological adaptations in farming brought by the "Green Revolution." The Green Revolution has bought agricultural gains by paying high water and fertilizer costs, which may be unsustainable. Even greater productivity is needed to meet the nutritional needs of burgeoning cities, but the next generation of technological gains in nutritional productivity will be much harder to devise. In addition, the sustainability of our safety nets created to ensure food security is in jeopardy. These protections can be threatened by war, financial collapse, epidemics, and migration. Moreover, they are also vulnerable to social and economic policies reflecting ideologies that mask social Darwinism behind the language of "self-reliance" and "trickle-down" economics (17).

In the United States, hunger is well documented as a major public health problem. Nuanced discussions of the reliability of various measures of hunger fail to obscure the fact that many people, including millions of children, are hungry. Whether the study is measuring "food insufficiency" ("an inadequate amount of food intake due to lack of resources") (18), "food insecurity" (the fear of not having

enough to eat), or "hunger," even loosely defined, the statistics are alarming (19). National surveys in the 1990s report a range from 2.4 million to 5.5 million children under 12 years old who are hungry each year (20,21). Research based in clinical settings confirms the validity of these findings. Some studies, such as one conducted in a hospital pediatric clinic in Minnesota, found even higher rates of hunger among children. More than 6% of their patients were found to be hungry and 32.7% of their patients were at risk of hunger in the near future (22). In another hospital, 12% of an adult patient sample reported they lacked adequate food, and 13% had gone without eating an entire day because of lack of food (23). The public health consequences of hunger are obvious. Even in the absence of clinical malnutrition, hunger is associated with increased incidence and virulence of infectious diseases, school and work absences, fatigue, and problems with concentration (24).

Increasingly, advocates are recognizing the potential of urban gardening as a significant link in urban food security in the United States. Many low-income and immigrant urban gardeners already rely on produce from their gardens to put food on their tables (25). It is likely that many more people would take up gardening for food if they were supported with knowledge, tools, and space. A recent unpublished needs assessment at an Omaha Nebraska Cooperative Extension Nutrition Education Program indicated that two-thirds of the program participants said that they ran out of groceries by the end of the month. Eighty percent of the participants reported that they would like a garden in their community where they could grow fresh produce.

The extent to which urban gardens can impact hunger depends necessarily on the amount of produce grown. Garden yields vary according to the availability and condition of land for gardening, the seed species, weather conditions, the reliability of a water source, the length of the growing season, and the gardener's skill. Even given these constraints, researchers have observed that urban gardens can produce significant yields from small plots of land. One researcher calculated that under average growing conditions in a 130-day growing season, a 10 by 10 meter plot can provide a household's yearly vegetable needs, including much of the household's nutritional requirements for vitamins A, C, and B complex and iron (26).

Although typically smaller, household gardens in urban settings in the United States can measurably supplement dietary intake (27) and reduce overall household expenditures on food (28).

Urban commercial gardens in the United States characteristically use intensive methods of agriculture, so their yields are generally 13 times more per acre than rural farms (29). Furthermore, the close proximity of urban farms to markets saves transportation costs. Interestingly, however, urban commercial gardens do not always increase food security, at least directly, for impoverished urban neighborhoods. To maximize their financial margins, urban commercial growers usually raise specialty crops and flowers, and manufacture value-added products for sale at top prices to up-scale restaurants, grocery stores, and farmers' markets. With a ready and eager market for their products, and given a good climate and business savvy, an urban farmer in the United States can expect an income of $1,000 to $10,000 and more from an acre of land (30).

Since economic factors are undeniably the single most powerful predictors for food security, successful urban entrepreneur gardens could be said to benefit indirectly the nutritional health of a community by providing income and employment opportunities for low-income households and thereby contributing to their ability to purchase a healthy diet. This form of urban agriculture has the advantage of being a relatively accessible industry, especially for low-income entrepreneurs. Someone can begin a market garden on a small scale without a lot of capital or technical skill and expect some return on his or her investment. As the 1996 United Nations report on Urban Agriculture states,

> . . . an enterprising farmer can, over time, improve the inputs, increase skills and knowledge, enhance the efficiency of production and widen the scale of the activity—all with incremental investments. (31)

Several youth training programs in the United States are designed to teach the horticultural and marketing skills needed to take advantage of such opportunities. The most financially successful of such programs to date is the "Food from the Hood" project in Los Angeles (32). There, high school students have raised over a hundred thousand dollars for college scholarships through the sale of their salad dressing.

Policy Recommendations

These entrepreneurial youth gardening programs and the financial success of many urban growers could have an important influence on inner-city economic development and thus, public health. However, in order for such opportunities to ensure long-term economic alternatives to inner-city growers, they will need assistance similar to the financial supports available to rural farmers, such as crop insurance and loans, so their businesses can survive agriculture's perennial hazards of market slumps and climate disasters. Additional public and private funds needed to incubate economic opportunities deriving from urban entrepreneurial gardens, and related businesses such as farmers' markets, nurseries, and composting facilities, are also prudent public health investments. Health policy-makers can additionally address policy changes that increase access to certified kitchens for safe food preparation and expedite market vendors' use of WIC vouchers and food stamps. Furthermore, food pantries, schools, and surplus commodity programs can be encouraged to serve healthier food choices that include locally-grown fresh foods. Public and private funding for initiatives like the USDA Food Security program can create the opportunity for even more comprehensive responses that link low-income consumers and local produce growers. New economic policies may be needed as part of such a comprehensive approach. For instance, the North Omaha Food Security Policy Council is currently investigating the practice by some national food distributors that use purchasing incentives and disincentives to discourage local grocery stores from buying regionally-grown produce.

Public health professionals can also foster increased food security in ways that are more consistent with their traditional roles. For example, food safety experts can provide education for gardeners and consumers about proper handling, preparation, and storage of fresh foods. They can work with entrepreneurial growers to ensure that existing health regulations are relevant to small scale operations. And public health educators can assist consumers with culturally-appropriate recipes and information about the health benefits of garden fresh foods for decreasing the risks of specific diseases.

PERSONAL WELLNESS AND COMMUNITY BETTERMENT

In addition to its contribution to food security and nutritional health, urban agriculture in the United States has reportedly had other positive effects on individual health and overall community improvement. Horticultural therapists have long recognized the benefits from physical exercise in gardening. Gardening activities range from fine motor involvement when cutting flower stems, for instance, to aerobic gross motor tasks such as turning a compost pile (33). Also, the psychological and social benefits of gardens have been well documented. In a 1995 monograph from the American Community Gardening Association (ACGA), David Malakoff notes that many of these publications are assembled in a bibliography of over 1,200 articles available through the Plant-People Council (34). The Plant-People Council is a coalition of horticulturalists and the horticulture industry working to promote awareness of plant-human interactions. The articles in the Council's bibliography document multiple ways that plants and gardening contribute to an improved quality of life and overall health. For example, recreational gardening has been observed to be a way to relax and release stress. Malakoff's literature review covers numerous studies that document how "simply looking at a plant can reduce stress, fear, and anger, and lower blood pressure and muscle tension" (35). As such, gardens and gardening have been incorporated with good effect in patient care (36) and prison environments (37). In the urban landscape, gardens can create respite from the noise and commotion of city life.

The stress-reducing benefits of gardens in cities can even affect passersby. This relationship was explored in a study in an impoverished neighborhood in Atlanta, Georgia. Community psychologists studied the ecological relationship between several aspects of the neighborhood's physical environment such as open dumps, parks, fenced yards, marked cross walks, trees, and gardens with social problems such as fires, violent deaths, mental illness, and juvenile delinquency. The mere presence of vegetable gardens featured significantly in this research as a positive community influence (38). Other studies have documented the potential of inner-city gardens for reducing crime. Malakoff's ACGA monograph reviews two unpublished reports, one from Philadelphia (39) and another from San

Francisco (40), that observed marked reductions in burglaries, thefts, and illicit drug dealing in neighborhoods with garden projects.

Urban agriculture has also created opportunities for leadership development and community organizing and thus has contributed to communities' "social capital." The political effort to develop and sustain urban gardens and other "greening" activities requires complicated knowledge and skills to navigate government offices, access public resources, persuade funders, and deal with complex social relationships. When low-income neighborhoods and market gardeners become involved in transforming their urban landscapes and claiming for themselves a sense of place and pride, urban agriculture has become a forceful empowerment strategy for community participation and social change (41). The ACGA monograph refers to a student's unpublished thesis in this regard that observed how,

> The pathways to power . . . can be relatively modest. Simply attending a community meeting on a garden project, for example, can introduce residents to non-profit and government officials they might never have known about—and vice versa. (42)

Policy Recommendations

The public health advantages from community enhancement, stress-reduction, and beneficial physical activity make a good case for community-based policies that encourage the sustainability of urban gardens through far-sighted urban planning. For instance, secure land tenure is needed for community and entrepreneur gardeners in the urban context. Zoning policies and laws regarding land use, tenancy, and ownership impact the viability of urban gardens and may need local adjustment to fit hitherto unanticipated requirements for gardens. Similarly, water rights and fees, as well as the regulated use of non-potable "gray" water may need modification.

Future public health advantages from urban gardens could be further enhanced if gardens were incorporated along with parks and wildlife corridors in a city's overall plan for "green space." Many cities are embarking on more or less ambitious plans for such varied uses, and some even include limiting suburban expansion. It is conceivable that urban planners with a concern for food security and other public health issues will soon include suburban agriculture in

their planning as well. Many people who move to the suburbs do so in search of green spaces. As development continues, however, these spaces are almost invariably enclosed by malls, parking spaces, highways, and similar impervious surfaces. The resulting welter of signs, traffic, and shops has created some of the ugliest architectural areas imaginable. If green spaces and opportunities for small farming were required in suburban planning programs, some of these problems could be avoided and more food security and economic opportunity could be provided for suburban and urban populations alike.

Another area for public health policy consideration pertains to security. Urban gardeners may well contribute to public health through violence prevention in and around their gardens. However, it would be helpful to have more a systematic understanding of and support for the social and economic influences that create and sustain safe gardens. Local police, citizen patrols, and concerned neighbors all seem helpful in protecting gardeners from harm and gardens from theft and vandalism. In some cities, fencing is required. The expenditure of public funds to mobilize these strategic safety measures and to study their effect should be encouraged as a wise investment in overall public health through community-building. Especially if food problems were to become severe in even harder economic times, greater security measures may need to be observed in urban gardens.

Ample research and commentary document urban agriculture's overall positive physical and psychological health effects. More research, however, is needed to understand the prevalence of potentially harmful impacts on health, particularly for those who are involved in market gardens, where the stress from depending on agriculture for a livelihood, the physical strain of hard, repetitive labor, and the risks of injury from farm machinery and of toxic exposures to agricultural inputs would likely compare to the experience of their rural counterparts. Health department professionals and others can assist with targeted prevention education and campaigns focused on safe handling of tools, machinery, and agricultural chemicals.

ENVIRONMENTAL HEALTH

Urban agriculture presents benefits and challenges for environmental health, impacting gardeners, their neighbors, and, in the case of commercial growers, their distributors and customers. One area of concern is the danger of toxic contamination from agricultural products

such as chemical fertilizers and pesticides, including herbicides, insecticides, and fungicides. Not only are the growers themselves at risk of health problems from exposure to these chemicals, others unrelated to the agricultural endeavor can be affected, especially in densely populated areas. Carried by the wind, sprays of these chemicals can easily overshoot a garden's boundaries and contaminate the surrounding neighborhood. Similarly, run-off from rain and a garden's irrigation system can carry these chemicals into storm drains to contaminate the city's sewage system or pollute rivers and the water table (43). Interestingly, the premium market for produce raised without chemicals has created a significant incentive for urban commercial growers to decrease their use of harmful pesticides and fertilizers. Many community gardens restrict the use of these chemicals as well. However, home use remains largely unregulated, and pesticides applied to lawns may drift to nearby gardens.

Soil and water pollution from nearby industry and highways can also pose serious health risks for urban agriculture. Airborne lead, other heavy metals, and toxic organic industrial wastes can settle on garden soil, plant leaves and fruits. When not properly washed before they are eaten, fresh crops thus expose consumers to these pollutants. By requiring lead-free automobile gasoline, federal policy has decreased the rate of new lead contamination of our urban soils in the United States. However, the soil in gardens located on or downstream/downwind from former industrial sites and highways may still harbor a build-up of hazardous manufacturing residues and automobile exhaust. Plants actually take up these contaminants into their leaves and fruits where, in quantity, they can become dangerous to consumers. Children, pregnant women, and adults with compromised metabolic systems may be especially vulnerable in this regard (44).

This tendency for plants to incorporate heavy metals and other contaminants can, however, also be a relatively straightforward remedy for cleaning up polluted soils. Called "phytoremediation" (a plant-specific form of the larger classification, "bio-remediation"), this process has successfully extracted lead, chromium, and other pollutants from soils and water (45). According to some reports, plants can even be used economically to mine useful minerals such as gold (46). Some toxic materials are rendered harmless by plants, but others are simply taken up into the plants which themselves then need to

be disposed carefully. An alternative to phytoremediation is to remove the soil from a contaminated site and replace it with clean fill. With the help of state and federal funds, one innovative commercial tomato grower in Buffalo, New York, has taken over an industrial "brown field," or contaminated industrial site, and simply substituted a hydroponic growing medium. His tomatoes grow safely in sealed boxes without ever touching the soil.

Composting organic materials can serve as another form of bioremediation for contaminated urban soils. Bacteria and other microorganisms involved in the composting process can break down many chemical contaminants. And, when raised to sufficiently high temperatures, composting can sterilize infectious bacteria as well. Adding organic material such as compost to soil also diminishes the likelihood that contaminants will be taken up by plants (47). Composting, when properly done, can further contribute to public health by enriching garden soils and thereby reducing the need for chemical fertilizers. The biological activity of microscopic creatures in the soil also reduces the need for pesticides. In addition, urban composting systems have been demonstrated to be an excellent recycling strategy for significantly reducing a city's solid waste stream.

Composting, whether a large municipal operation or a backyard compost pile, requires regular aeration and the right balance of materials; otherwise, it will stink and attract rodents and flies. Furthermore, not all urban compost is safe for use in gardens, especially vegetable gardens. For instance, whether and how composted sludge containing urban sewage is used in agriculture is the topic of current policy debate because of the dangers of bacterial and chemical contamination (48). Even small-scale organic urban gardeners need to be careful of their sources of biomass for composting, since many urban householders use chemically active pesticides and fertilizers on their lawns.

On balance, however, even given the environmental concerns associated with urban agriculture, there remains much positive to be said for its benefits to urban environmental health. The transformation of an unsightly and dangerous lot into an environmentally healthy and beautiful garden can reap enormous benefits for an inner-city community. Gardens increase a city's biodiversity with plant variety and by attracting beneficial soil microorganisms, insects, birds, reptiles, and animals. Urban green spaces can also play a role in species preservation for birds and butterflies by providing food, resting spaces, and

protection along migratory flight paths. Furthermore, urban agriculture can reduce soil erosion and ground water contamination when appropriate safeguards and practices are used. And plants not only absorb soil contaminants through their root systems, they also can reduce air pollution by absorbing pollutants through their foliage.

Policy Recommendations

Urban gardening raises our public awareness of the need to safeguard our environment, and especially our urban soils, from future pollution, erosion, and neglect. Rarely do urban dwellers think about soil as a valuable resource; in fact we rarely think about it at all. The ground underfoot is largely taken for granted, as a surface for transportation, recreation, or when bare, a future building site. And yet, soil can be the foundation of either a public health hazard or an asset for urban communities. When it has been allowed to become a dangerous depository of heavy metals and chemical toxins, soil threatens our health. On the other hand, when soil is nurtured, it can become a safe harbor for thriving plants that create nourishment, aesthetic pleasure and healthful environments.

In order to protect the health of urban soils, and thus our own well-being, we need to strengthen regulatory policies that monitor and enforce environmental safety laws pertaining to fuel additives and industrial emission drift and runoff. Furthermore, there must be scrupulous control of the use of sewage sludge containing industrial residue and bacteria which cannot be properly degraded to the extent that they are rendered harmless. Public health professionals need to be involved in writing and revising regulations pertaining to these significant environmental protections.

Public health input is also needed to improve regulation of home use and disposal of the vast array of chemical herbicides, pesticides, and fertilizers used in urban gardening. In this regard, health departments can be instrumental in decreasing "downstream" pollution by contributing to consumer education campaigns and ensuring more accessible public facilities for residents to dispose of harmful substances. Public health perspectives can also be persuasive in "upstream" initiatives involving the limitation and even banning of a number of chemical compounds that are currently sold over the counter in hardware and gardening supply stores. Existing federal and state laws require labeling that is actually quite clear for the con-

sumer who is apt to read and comply with the stated directives for use. However, consumers are known to make basic mistakes in application, for instance using excessive concentrations or using the product inappropriately. It may then spread beyond the targeted area on a windy day or just before a rainfall. It is not uncommon for consumers to misinterpret a product's intended purpose entirely, for example using an insecticide as a weedkiller or vice versa, using a herbicide to control insects, and thus neither accomplishing the desired effect nor protecting biodiversity.

Although little may be done at the policy level to regulate mistakes that occur in the privacy of a home or community garden, much can be done to limit the potency of the chemicals being used in these contexts. For instance, in the area of product packaging, this form of environmental pollution can be managed more effectively by requiring manufacturers to sell only pre-diluted concentrations. Limiting the availability of broad-spectrum pesticides and herbicides that kill beneficial creatures along with the noxious ones would also reduce unnecessary environmental risk. In addition to rethinking product packaging, public health professionals can work toward limiting horticultural uses of chemicals already banned in other household products. A case in point are phosphates which are banned from laundry detergent but are readily available in many pre-packaged chemical fertilizers. When used in excess of plants' ability to absorb them, phosphates can cause havoc if washed into the ground water (49).

It may also be useful to re-investigate the potential in some inner city contexts for raising small animals, such as rabbits, for food. Although raising animals poses more health hazards than vegetable production, and many cities severely restrict animal husbandry, a careful approach to clean and safe methods of raising animals could contribute to the variety and protein content of urban diets. Human vegetarian diets provide nutrition more efficiently in terms of land area and inputs than meat production generally. But small amounts of meat can be useful in supplementing and stabilizing diets. Animal husbandry can be absorbing and educational for youth gardeners. And animals can convert otherwise inedible grass and kitchen wastes to usable food and bank protein against hard times. Furthermore, animal waste, when composted properly, can be recycled to increase soil fertility.

In order to realize the potential advantages and minimize the

health problems associated with raising animals inside city bounds, public health professionals must be involved in revising and enforcing relevant safeguards. As with our other recommendations for public health input on environmentally sustainable urban agriculture, effective policy impact will require overcoming the traditional statutory and organizational segmentation of the field of environmental health. Health issues involved with urban gardens cut across the jurisdictions of many public agencies, including local, state, and federal offices for environmental quality and protection, agriculture, parks and recreation, fish and game, city planning and zoning, police, and public health. For public agencies to agree to collaborate among themselves and to work with non-profit environment and gardening advocacy groups and the private sector will be important first steps towards achieving comprehensive responses that foster the promise of urban gardens to enhance environmental health.

CONCLUSION

Like many other public health problems, those identified in this paper can best be remedied through fundamental changes in society, including

- the elimination of poverty by income redistribution, quality education, and full, meaningful employment;
- the control of environmental pollution by stringent regulation of polluters, massive remediation programs, and viable recycling and re-use policies;
- the alleviation of hunger by ensuring availability of and access to affordable, sufficient, and healthy foods;
- the preservation of "green space" through enforcement of environmentally sustainable city planning, economic policies, and incentives that curtail sprawl and encourage biodiversity.

However, short of these examples of basic restructuring, or on the way there, we have detailed a number of significant policy changes that public health professionals, working with governments, businesses, neighborhoods, and individuals, can use to advance the significant potential of urban gardening for public health. Developing and sustaining gardens as part of initiatives for urban food security, environmental stewardship, employment opportunities, community organization, and enhanced quality of life will necessarily require

comprehensive and multifaceted support and planning, but the result of such activity will reap significant rewards.

As we look ahead to the public health needs of the 21st century, the foundations of human health will need to come to terms with its dependency on the limited capacity of the global environment to support intensive human activity (50). This means that healthy cities will have to minimize their environmental impact and reduce their dependency on energy-intensive transportation of distant sources of food and other products. In order to live closer to nature without eroding wild spaces, many millions of urban dwellers will need to integrate green spaces, and perhaps animal husbandry, into the geography of cities. Jobs will have to become more green and depend less on extraction and intensive industrial activity. Urban gardening integrates these three important elements of successful public health in the 21st century: food security through local sources, urban greening, and environmentally efficient employment. Although the public health achievements of 1900 depended on large industrial projects, such as massive water and sewer systems, the public health achievements of 2000 will depend on our ability to coordinate complex, materially modest networks of human activity in support of simple and healthy ways of life, an essential component and key symbol of which is gardening.

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ABSTRACT

The article presents the case for stronger public policies in support of urban gardening as a means to improve public health. It considers several beneficial aspects of gardening, such as food security, economic development, exercise, psychological and community well-being, and environmental stewardship. It also considers some of the public health problems associated with urban agriculture and suggests policies to ameliorate them. In the balance, urban gardening has potential as an important element of urban public health.