OUTCOMES/BENEFITS OF URBAN AGRICULTURE SUPPORTED BY THE EVIDENCE BASE

TABLE OF CONTENTS

HEALTH

Healthy Eating & Food Health Literacy

- Community gardens have been found to improve healthy eating, such as increased fruit and vegetable consumption and preference among participants, regardless of setting or population.[1, 2, 3, 4, 5, 6, 7, 8,9, 10,11]
- Taste and the tactile experience of eating freshly picked produce have been identified as variables associated with increasing fruit and vegetable consumption. These are also the identified motivational factors for gardening and buying from local farm producers. Gardeners additionally save money and grow regional and cultural favorites that they might not be able to find in the markets. [12,13,14,15,16,17,18,19, 20]
- Aliamo (2008)[21] found that this effect also held true for household members who did not personally garden.
- Practical experience with food – cultivation, harvesting, purchasing in stores and farm stands, cooking – influences dietary knowledge and practice. Whether out of pride, pleasure, or nutritional sophistication, gardeners, including youth, eat what they grow and what they

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know.[22,23,24,25, 26, 27, 28, 29, 30,31]

- Local foods may affect health and nutrition in one of two general ways. First, local food systems may offer food items that are fresher, less processed, and retain more nutrients (e.g., because of shorter travel distances) than items offered in nonlocal systems. For example, locally obtained food may be healthier because "freshly picked foods ... retain more nutrients than less fresh foods".[32] Consumers may purchase the same amounts and types of fruits and vegetables, but since local foods are fresher, the nutrient content of diets is improved. Whether or not local food systems tend to improve health and nutrition in this way is largely an unresolved empirical question. Locality may be only one factor that determines product freshness or retention of nutrients,[33] and a link between travel distance and nutrient content has not yet been established.[34]
- Local food systems may increase the availability of healthy food items in a community and encourage consumers to make healthier food choices. For this to be true, at least two conditions must be met: Local foods systems must increase the availability of healthy food items in a way that is infeasible or impractical for non-local systems, and consumers who purchase local food must make different dietary choices that they would not have made without the local option available.
- Morland et al., (2002)[35] and Moore et al., (2008)[36] suggest that improved access to healthy foods is associated with healthier dietary choices. Also, anecdotal evidence indicates that CSA membership is associated with increased fruit and vegetable consumption.[37,38] However, it is not clear that there is a relationship between improved access and health outcomes,[39, 40] or that local

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characteristics, as opposed to access in general, play a role in consumer and dietary choices.

- Introducing healthy food options in schools may be an effective means of improving children's diets. Farm to school initiatives that increase availability, reduce prices, and provide point of purchase information have been found to be effective strategies to increase fruit and vegetable consumption in schools.[41] What is still unclear is whether local characteristics are driving these results, or if innovative curricula and cafeteria menu changes are responsible. For example, McAleese and Rankin (2007)[42] found that children exposed to a garden-based education curriculum reported greater fruit and vegetable consumption, even though no effort was made to improve the availability of local foods at the schools.

Mental Health

- Studies pointed to improvements in multiple areas of health due to participation, such as a significant increase in Total Emotional Score among an older adult population, and a greater amount of physical activity among youth and adults.[43,44,45,46]
- Some individuals partake in community gardening activities purely because they view it as a leisure or recreational activity. Fifteen percent of the articles stated enjoyment or relaxation as the motivating force or benefit of participation.[47,48,49,50,51,52,53,54] Among these, Ferris and colleagues (2001)[55] found that the most prominent type of community garden found in the San Francisco Bay area was leisure gardens; they often served as a sites for apartment-dwellers to garden or to simply enjoy the outdoors.
- "Working with plants and being in the outdoors trigger both illness prevention and healing responses. Health professionals use plants and gardening materials to help patients of diverse ages with mental illness improve social skills, self-esteem, and use of leisure time.[56,57,58,59]

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Horticulture therapy promotes plant-human relationships to induce relaxation and to reduce stress, fear and anger, blood pressure, and muscle tension."[60,61,62,63]

Physical Activity

- "When self- identified as exercise by research subjects or isolated by researchers, gardening has been connected to reducing risks of obesity (children and adults),[64,65] coronary heart disease (for women and for men, notably menopausal women and elderly males),[66,67,68,69,70,71,72,73,74] glycemic control and diabetes (adults, elderly men, Mexicans and Mexican-Americans),[75,76,77] and occupational injuries (railway workers)."[78]
- "Research shows that gardening is a preferred form of exercise across age, gender, and ethnicity.[79,80] Overall, older persons do more gardening than younger ones.[81,82] Even moderate forms of garden exercise increase muscle strength and endurance in activity-reduced persons including pregnant women, cancer survivors, and those generally sedentary."[83,84,85,86,87,88]

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- "Men identify gardening as "exercise" more often than did women though women and men report similar amounts of time gardening.[89] Women may associate gardening with gendered household food-related chores rather than exercise."

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SOCIAL

Community Organizing, Empowerment, and Mobilization

- Because community gardens provide a social space for individuals to join together, community organizing often results through the interactions.[90,91,92,93,94,95,96,97,98,99,100,101,102] The land rights disputes that took place in New York City between garden advocates and the Giuliani administration illustrates this effect on a citywide scale, and even beyond. Community gardeners, along with other supporters, gathered in force and were able to preserve 500 gardens through organizing efforts such as protests, parades, community festivals, and press conferences.[103]

Social Capital, Conflict Resolution & Social Cohesion

- Many studies assess social processes that take place within a community garden setting, and how these processes often translate to situations outside of the immediate garden context. Glover (2004)[104] found that the community garden formed due to social capital, and additional studies showed that such a garden also served as a source of social capital once established; to elaborate. Collective efficacy increased; participants accessed resources needed for their community garden from inside and outside their immediate garden network, and through weak and strong social ties; and participants viewed the community garden as a way to successfully bring together people of different races and other people who would not normally socialize.[105,106,107,108,109]

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- Teig and colleagues (2009)[110] found that the multiple social processes (e.g., mutual trust, reciprocity) fostered during participation translated into situations outside of the community garden setting, and other studies found that the relationships formed led to a stronger overall sense of community.[111,112,113,114,115]
- Multiple studies have examined community gardens that were threatened due to land rights issues. The conflict between garden advocates and the Giuliani Administration in New York City was most studied.[116,117] Authors found that the conflict served as an instigating force for the organizing and mobilization of gardeners. This occurred with gardeners from multiple sites, who would not normally interact with one another, as well as people outside of the immediate gardening network and even city. Hundreds of community gardens were saved due to the collective voice that was produced and tactics of resistance that were used, such as through internet usage and protests.[118,119]

Food Security

- For a household to be considered food secure, all household members must "have consistent, dependable access to enough food for active, healthy living". The USDA (2009) found that 14.6% of US households were considered food insecure at some time in 2008, an increase from 11.1% in 2007.[120] One-fourth of the studies reviewed mentioned food production as a benefit or motivating force for participation.[121,122, 123,124, 125,126,127,128,129,130,131,132,133,134]

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- Community and residential gardening, as well as small-scale farming promote nutrition and free household income for non-garden foods and other needs.[135,136,137,138] Approximately every $1 invested in a community garden plot yields $6 worth of vegetables.[139] Cooperative buying partnerships with urban area farmers, Community Supported Agriculture (CSA), maximizes food quality at stabilized prices. Household garden donations and farm gleaning projects increase emergency food providers' access to their scarcest commodity, fresh fruits and vegetables.[140]
- A one-acre vegetable garden, established as a component of a diabetes education program on an American Indian reservation, produced 6,000 pounds of fresh produce, in 1 year, which was distributed primarily amongst tribal elders.[141] Similarly, 501 West Philadelphia community gardens produced $1,948,633 worth of fruits and vegetables in a single year, helping to feed, at a minimum, the 2,812 families directly involved in the gardens. Gardeners consciously planted foods that were either unavailable or expensive in local stores.[142] Gardeners often chose to donate a portion of their produce, typically to senior citizens, homeless, or poor individuals and families, improving food access for those within the larger community.[143,144,145,146,147]
- Urban agriculture provides a buffer both against local economic insecurity as well as periods of war and conflict that can disrupt normal food flows. Gardeners share food with friends, families, and neighbors as well as members of their community in need, for example, through the "plant-a-row" project that encourages gardeners to set a specific space aside for donations.[148]
- Local food characteristics have commonly been associated with efforts to improve food security, particularly at the community level. Food security means that all people at all times have access "to enough food for an active, healthy life," and is a necessary condition for a nourished and healthy population.[149] Those who are food insecure have limited or uncertain availability of healthy and safe food or have uncertain ability to acquire food in normal ways. As of 2008, more

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than 6.7 million households in the United States had very low food security (i.e., multiple instances of reduced food intake and disrupted eating patterns).[150]

- Direct marketing has been a key component of community food security programs, with the goal of reducing community food insecurity and supporting rural communities by strengthening traditional ties between farmers and urban consumers.[151] In particular, farmer's markets have been associated with food security programs because they are increasingly capable of accepting benefits from Federal and State food and nutrition programs (e.g., food stamps).[152]
- The potential for local food systems to improve food security is conceptually similar to claims related to health benefits. That is, expanding local food options may increase the availability of healthy food items, particularly in areas with limited access to fresh food. The prevalence of healthy food items may encourage increased intake of fruits and vegetables, and improved availability may reduce problems related to food access and uncertainty.
- An implicit assumption in this argument is that local food systems improve access and reduce uncertainty.[153]
- Despite the use of local foods as a strategy to reduce food insecurity, little research has been conducted to examine its efficacy in reducing insecurity. Evidence suggests that healthy eating habits are associated with participation in the Senior Farmers' Market Nutrition Program,[154] and in the WIC Farmers' Market Nutrition Program when nutrition education accompanied coupon distribution.[155] These programs have been cited as important components that impact food security.[156] However, while these studies make the case that programs with local food characteristics impact healthy food choices, food security is influenced by other factors, such as economic conditions, income, and poverty status.[157,158] No study has attempted to demonstrate a clear relationship between these factors, observed food security, and local food characteristics.
- The potential for local foods to affect food security may be limited by several factors. For example, farmers' markets may experience low-volume sales that are similar to those faced by other retailers in low-income neighborhoods.[159] There is also no *a priori* expectation that local food systems will address the needs of low-income households who are subject to food insecurity. Prices depend on the market dynamics in a particular location. Prices for some products in local food markets may be comparable to or below prices in other markets in a community, but may be higher for other products or in other locations.[160] For example, some farmers may use local food markets as a residual or supplemental revenue stream and be willing to accept lower retail prices than farmers who use local markets as their primary source of income.

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Youth Development

Social asset building

- Youth gardening programs have been found to promote youth development (e.g., social relationships, respect for other individuals and cultures).[161,162,163,164]
- Self esteem and life skills.[165,166,167,168]

Healthy Eating

- Gardening-enhanced nutrition programs increased participants' nutrition knowledge; fruit and vegetable consumption, preference, and asking behaviors at home; physical activity; and gardening self-efficacy.[169,170,171,172,173,174,175]

Academic outcomes

- Increase science learning and achievement.[176,177,178]
- Articles also discussed community gardens as a means to provide an effective participatory learning opportunity for youth, which led to improvements in academic performance and social skill development.[179,180,181] Related to youth gardening, researchers surveyed teachers and principals to determine the reasons for having a school garden. Academic instruction

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enhancement, edible produce production, and extracurricular activities were most frequently reported.[182,183]

Safe Spaces

- Community gardens can provide a safe space for individuals and families to gather and relax, especially for those who would not otherwise have easy access to such areas. For example, Latino community gardens in New York City were identified as the only open spaces available within the neighborhood.[184]
- Although no articles quantitatively measured the effects of community gardens on crime rates, community members stated that there was a noticeable difference in their surrounding area once one was established.[185,186,187,188,189,190,191,192,193,194]
- Allen and colleagues (2008)[195] mentioned that grants from the Neighborhood Violence Prevention Collaborative, in Flint, MI, provided the initial funds for community gardens in the city, which served as the impetus for larger community-based violence prevention initiatives.

Cultural Preservation and Expression

- Community gardens have been written about as important mechanisms by which communities preserve, express, and affirm their culture. Latino community gardens in New York City exemplify this purpose. Saldivar-Tanaka and Krasny (2004)[196] found that the structures, design, and plants within the 20 Latino-operated gardens that they studied reflected the participants' country of origin (e.g., use of casitas: wooden-structures originally found in Puerto Rico). Events held in the gardens provided opportunities for cultural expression through dance, musical performances, and food focused activities.[197] On a smaller scale, a garden used within an afterschool program in Oklahoma helped affirm and preserve Native American culture (e.g., the traditional "three sisters" garden was planted with corn, beans, and squash. [198] Six articles illustrated similar opportunities

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[182] Graham, H., & Zidenberg-Cherr, S. (2005). California teachers perceive school gardens as an effective nutrition tool to promote healthful eating habits. Journal of the American Dietetic Association, 105, 1797–1800.
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[198] Robinson-O'Brien, R., Story, M., & Heim, S. (2009). Impact of garden-based youth nutrition intervention programs: A review. Journal of American Dietetic Association, 109, 273–280.

for cultural preservation, expression, and affirmation.[199,200,201,202,203,204]

Social Interactions/Cultivation of Relationships

- The collective nature that differentiates community gardens from private gardens means that social interaction is inevitable and the cultivation of meaningful relationships are likely to occur. Almost two-thirds (n = 33) of the articles reviewed support this claim; they mentioned the social actions that facilitate the establishment of community gardens and help ensure their sustainability.[205,206,207,208,209,210,211,212,213,214,215,216,217,218,219,220,221,222,223,224,225,226,227,228,229,230,231,232,233,]

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[234,235,236,237,238,239] The cultivation of relationships does not solely apply to interactions that take place between individual garden participants, but also includes the involvement of those outside of the immediate garden context. Collaborative efforts with entities such as universities, Cooperative Extension offices, summer youth programs, not-for-profit organizations, banks, and health centers were some of the many examples mentioned regarding involvement of the larger community; these relationships provided resources for gardens (e.g., volunteers, financial assistance, technical assistance) that were not available among garden participants themselves.[240,241,242]

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ECONOMIC

Local Economic Stimulation & Job Growth

- "The expansion of local food markets implies that consumers in a particular area are purchasing more of their food from nearby sources, and that more of the money they spend remains in their local community. Hence, local food systems have the potential to positively impact the local economy. Claims of economic development impacts—in the form of income and employment growth—are common in local foods research. Ross et al. (1999),[243] Marketumbrella.org (1999),[244] Marsden et al. (2000),[245] and Ikerd (2005)[246] suggest that expansion of local foods may be a development strategy for rural areas. Zepeda and Li (2006),[247] Darby et al. (2008),[248] Lawless et al. (1999),[249] and Starr et al. (2003)[250] cite farmers' retention of a greater share of the food dollar by eliminating money going to the "middlemen" as a possible benefit. Roininen et al. (2006)[251] assert that local food systems may encourage growth in local labor markets."
- "The most direct way that expansion in local food systems could impact local economies is through import substitution. If consumers purchase food produced within a local area instead of imports from outside the area, sales are more likely to accrue to people and businesses within the area. This may then generate additional economic impacts as workers and businesses spend the additional income on production inputs and other products within the area."[252]
- "Shifting the location of intermediate stages of food production and direct- to-consumer marketing can also be considered forms of import substitution. For example, shifting processing activities (e.g., beef slaughtering and processing) to the local area may result in a larger portion of the value of the finished product remaining in the local area. Part of this effect may be due to producers retaining a greater share of the retail price of their products as they assume responsibility for additional supply chain functions (e.g., distribution and marketing)."[253]
- "Empirical studies suggest that local foods can have a positive impact on local economic activity through import substitution and localization of processing activities. Using an input-output model (see box, "Input-Output Models and the Multiplier Effect"),[254,255] predicted that locally produced fruits, vegetables, and meat products would increase output, employment, and labor incomes in

[243] Ross, N.J., et al. 1999. "Trying and Buying Locally Grown Produce at the Workplace: Results of a Marketing Intervention," American Journal of Alternative Agriculture, Vol. 14, pp. 171-179.
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[250] Starr, A., et al. 2003. "Sustaining Local Agriculture: Barriers and Opportunities to Direct Marketing Between Farms and Restaurants in Colorado," Agriculture and Human Values, Vol. 20, pp. 301-321.
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[252] Swenson, D. 2009. Investigating the Potential Economic Impacts of Local Foods for Southeast Iowa. Ames, IA: Leopold Center for Sustainable Agriculture.
[253] Martinez, Steve, et al. Local Food Systems: Concepts, Impacts, and Issues, ERR 97, U.S. Department of Agriculture, Economic Research Service, May 2010.
[254] Swenson, D. February 2008. Estimating the Production and Market-Value Based Impacts of Nutritional Goals in NE Iowa. Ames, IA: Leopold Center for Sustainable Agriculture.
[255] Swenson, D. 2009. Investigating the Potential Economic Impacts of Local Foods for Southeast Iowa. Ames, IA: Leopold Center for Sustainable Agriculture.

Iowa. This was due, in part, to development of direct-marketing facilities and increases in local meat slaughtering and processing."

- "Farmers' markets have been found to have positive impacts on local economies. Otto and Varner (2005)[256] estimated that each dollar spent at farmers' markets in Iowa generated 58 cents in indirect and induced sales, and that each dollar of personal income earned at farmers' markets generated an additional 47 cents in indirect and induced income (multipliers of 1.58 and 1.47, respectively). The multiplier effect for jobs was 1.45; that is, each full-time equivalent job created at farmers' markets supported almost half of a full- time equivalent job in other sectors of the Iowa economy. Similarly, multi- pliers associated with farmers' markets in Oklahoma have been estimated to be between 1.41 and 1.78."[257]
- "The magnitude of the economic impact from import substitution depends on the sources of inputs for local production and processing (i.e., whether money spent on inputs is retained locally or not), and the degree to which a local supply chain displaces local economic activity that supported nonlocal products. This could include reductions in traditional commodity marketing (e.g., grains) or industries that support distribution and marketing of nonlocal food products (e.g., supermarkets)."[258]
- "Accounting for displaced economic activity within the local community reduces the positive economic impacts of localization, although estimated overall benefits are still positive. Swenson (2008)[259] assumed that an increase in acreage devoted to local fruit and vegetable production would replace corn and soybean acreage, which partially offsets some of the predicted economic benefits."
- "For small vendors (less than $10,000 gross sales), farmers' markets appeared to operate as a relatively low-risk incubator for new businesses and a primary venue for part-time enterprises in a nurturing environment.[260] These types of benefits are difficult to quantify because investments in business skills and development may take years to generate observable benefits. However, business skill development may be an attractive benefit in areas where few other options are available to acquire additional skills and market experience."
- "The presence of local food markets may also spur consumer spending at other businesses in a community. This spillover spending could support the retail sector in a community if, for example, a farmers' market draws consumers to an area where they would not have otherwise spent money. Lev et al., (2003)[261] found that many farmers' market shoppers traveled to downtown areas specifically to patronize the market, and also spent additional money at neighboring businesses."
- "These empirical examples suggest that the economic benefits of expanding local food systems can be unevenly distributed. Some sectors of the economy will lose sales, income, and jobs, while others will gain. Also, the geographic distribution of benefits and costs may not be uniform. By definition, economic benefits generated via import substitution in one location would result in reduced economic activity in areas from where the goods were previously exported. The location, distribution, and magnitude of these costs have not been studied for local food systems."[262]

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[256] Otto, D., and T. Varner. 2005. Consumers, Vendors, and the Economic Importance of Iowa Farmers' Markets: An Economic Impact Survey Analysis, Leopold Center for Sustainable Agriculture, Ames, IA. Accessed April 2009 at: http://www.leopold.iastate.edu/research/marketing_fi les/markets_rfswg.pdf

[257] Henneberry, S.R., B. Whitacre, and H.N. Agustini. November 2009. "An Evaluation of the Economic Impacts of Oklahoma Farmers' Markets," Journal of Food Distribution Research, Vol. 40, pp 64-78.

[258] Martinez, Steve, et al. Local Food Systems: Concepts, Impacts, and Issues, ERR 97, U.S. Department of Agriculture, Economic Research Service, May 2010.

[259] Swenson, D. February 2008. Estimating the Production and Market-Value Based Impacts of Nutritional Goals in NE Iowa. Ames, IA: Leopold Center for Sustainable Agriculture.

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[261] Lev, L., L. Brewer, and G. Stephenson. 2003. How Do Farmers' Markets Affect Neighboring Businesses? Oregon Small Farms Technical Report No.16, Small Farms Extension Program, Oregon State University, Corvallis, OR.

[262] Martinez, Steve, et al. Local Food Systems: Concepts, Impacts, and Issues, ERR 97, U.S. Department of Agriculture, Economic Research Service, May 2010.

- "It is also not clear how estimates of net economic benefits would be affected if the costs of public investments in local food markets are accounted for. Some programs have provided public financing to support local food systems for several years (e.g., the Farmers Market Promotion Program began in 1976), and local governments often either directly operate local markets or provide resources to support their operation (e.g., use of public space for markets). These costs have not been accounted for in existing research on the economic impacts of local food markets."[263]
- Ferris et al. (2001)[264] coined certain community gardens in the San Francisco Bay area "entrepreneurial gardens" (p. 563), due to the economic development opportunities they offered.
- A small plot of land can yield large amounts of produce, equating to significant monetary value and savings.[265] Saldivar- Tanaka and Krasny (2004)[266] estimated that in New York City, an investment of $5 to $10 in plants for a garden plot provides for a profit of $500 to $700 worth of fruits and vegetables.
- Other than helping supplement individual and family income, another way participants reaped the economic benefits of participation was through selling the produce to markets or restaurants.[267,268,269,270,271,272,273,274,275,276,277,278]

Youth Employment

- Community garden that provided wage-earning opportunities for youth, especially for ones considered at-risk or from low- income families.[279,280,281,282] In addition to the monetary benefits, youth employment provides for job-skill development, and community gardening experiences in general produce interpersonal skill improvements.[283]

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[263] Martinez, Steve, et al. Local Food Systems: Concepts, Impacts, and Issues, ERR 97, U.S. Department of Agriculture, Economic Research Service, May 2010.
[264] Ferris, J., Norman, C., & Sempik, J. (2001). People, land and sustainability: Community gardens and the social dimension of sustainable development. Social Policy and Administration, 35, 559–568.
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[266] Saldivar-Tanaka, L., & Krasny, M., (2004). Culturing community development, neighborhood open space, and civic agriculture: The case of Latino community gardens in New York City. Agriculture and Human Values, 21, 399–412.
[267] Ferris, J., Norman, C., & Sempik, J. (2001). People, land and sustainability: Community gardens and the social dimension of sustainable development. Social Policy and Administration, 35, 559–568.
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[282] Rahm, J. (2002). Emergent learning opportunities in an inner-city youth gardening program. Journal of Research in Science Teaching, 39, 164–184.
[283] Robinson, C. W. & Zajicek, J. M. (2005). Growing minds: The effects of a one-year school garden program on six constructs of life

- Behavioral improvements related to respectfulness, commitment, and positive teamwork were noted.[284,285,286,287,288,289,290,291,292]

Improved Community Livability

Neighborhood Beautification

- Many articles mention neighborhood beautification as either an intentional purpose or unintended benefit of community gardens.[293,294,295,296,297,298,299,300,301] Ohmer et al. (2009)[302] found this to be a primary motivation for people to participate in a community conservation program, which focused on establishing gardens throughout Western Pennsylvania as a way to help revitalize distressed areas.

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[285] Blair, D. (2009). The child in the garden: An evaluative review of the benefits of school gardening. Journal of Environmental Education, 40, 15–38.

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[295] Hannah, A. K., & Oh, P. (2000). Rethinking urban poverty: A look at community gardens. Bulletin of Science, Technology and Society, 20, 207–216.

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ECOLOGICAL

Biodiversity & Habitat Improvement

- "Many vegetated green infrastructure features can improve habitat for a wide variety of flora and fauna. Rain gardens and other vegetated infiltration features hold particular value in this regard insofar as they perform best when planted with native species. Ecological economists recognize two aspects of habitat which are preconditions for the provision of a whole array of ecosystem services. First, habitat is living space for both resident and migratory species. Second, habitat provides nurseries for species which live their adult lives elsewhere."[303]
- "Habitats are typically economically valued using either contingent valuation methods (especially where the conservation of an endangered species is concerned) or using the market price of traded goods that are harvested at the habitat in question (or of traded goods that are harvested elsewhere but for which the relevant habitat provides breeding and/or nursery grounds). The latter method can be useful, for example, in the case of coastal estuaries that provide nurseries for commercially harvested fish, but this approach is less applicable to the relatively small-scale urban vegetated features in question here. Contingent valuation studies might be more useful, but unfortunately, few have been conducted examining the habitat value of urban green space. Thus, this guide does not attempt to provide a framework for valuing this benefit."[304]

Reduced Noise Pollution

- "Green infrastructure, particularly vegetative practices and permeable pavement, have the added benefit of reducing noise pollution. Planes, trains and roadway noise are significant sources of noise pollution in urban areas—sometimes exceeding 100 decibels, which well exceeds the level at which noise becomes a health risk."[305]

Awareness of Food Systems Ecology

- "Gardens ground children in growth and decay, predator-prey relations, pollination, carbon cycles, soil morphology, and microbial life: the simple and the complex simultaneously."[306]
- Exposure to nature and gardening in childhood shapes adult attitudes and environmental values.

Food Miles, Energy Use & Green House Gas Emissions

- According to Pirog et al., (2001)[307] and Saunders and Hayes (2007)[308], food is traveling further from farmers to consumers as the food system increasingly relies on long-distance transport and global distribution networks. Concerns about fossil fuel use and greenhouse gas (GHG) emissions have increased scrutiny of the environmental impacts of transportation in the food system and the distance food travels to consumers. Advocates of localization of the food system argue that

[303] Center for Neighborhood Technology (2010). The Value of Green Infrastructure: A Guide to Recognizing Its Economic, Environmental and Social Benefits. Accessed April 10, 2012 at http://www.cnt.org/publications?issue=5.
[304] Center for Neighborhood Technology (2010). The Value of Green Infrastructure: A Guide to Recognizing Its Economic, Environmental and Social Benefits. Accessed April 10, 2012 at http://www.cnt.org/publications?issue=5.
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[306] Blair, D. (2009). The child in the garden: An evaluative review of the benefits of school gardening. Journal of Environmental Education, 40, 15–38.
[307] Pirog, R., et al. June 2001. Food, Fuel, and Freeways: An Iowa Perspective on How Far Food Travels, Fuel Usage, and Greenhouse Gas Emissions, Leopold Center for Sustainable Agriculture, Ames, IA.
[308] Saunders, C., and P. Hayes. 2007. Air Freight Transport of Fresh Fruit and Vegetables, Research Report No. 299, Agribusiness and Economist Research Unit, Lincoln University, Christchurch, New Zealand.

reducing transport distances for food, or food miles, can reduce fossil fuel energy use, pollution, and GHG emissions.[309,310] This claim has also been cited as a potential benefit of localization among local food system researchers.[311,312,313,314]

- Distance is clearly a factor that determines energy use and emissions resulting from food transport. Given two otherwise identical supply chains, the supply chain with greater food travel distance will use more energy and emit more pollution. But supply chains of different lengths (i.e., different number of production and marketing stages) are seldom identical; the mode of transport, load sizes, fuel type, and trip frequency all affect energy use and emissions.
- Saunders and Hayes (2007)[315] reviewed studies that focused on transport elements of the food supply chain, with emphasis on the United Kingdom. These studies highlight the importance of transportation mode in determining fuel use and carbon-dioxide (CO2) emissions. For example, cherries imported from North America had the highest ratio of emissions to product transported, reflecting the use of airfreight. On the other hand, apples imported from New Zealand traveled a greater distance, but had a lower emissions ratio because they traveled by sea, a highly energy-efficient means of moving goods.
- Saunders and Hayes (2007)[316] also reviewed several studies that compare energy use and emissions from locally sourced products, domestic products sourced from a mainstream retailer, and imported products. Transportation CO2 emissions were found to be greater for imported produce than domestic produce. Comparisons of local food systems to food sourced from mainstream retailers found no significant differences in transportation energy use, except for those products transported by air. The shorter distance traveled in local markets was offset by the greater transportation efficiency of the mainstream system, which lowered energy use per unit transported.
- Empirical studies of food transportation energy use and GHG emissions do not agree on whether local food systems are more energy- and emissions- efficient, reflecting great variation among local foods markets. In some cases, local and regional food systems are more efficient[317,318, 319, 320] and distance is an important factor in determining environmental impacts from transportation.[321] Others have found that distance is neither an adequate measure of impact,[322] nor particularly

[309] Thompson, E., Jr., A.M. Harper, and S. Kraus. 2008. Think Globally—Eat Locally: San Francisco Foodshed Assessment, American Farmland Trust. Accessed June 23, 2009 at: http://www.farmland.org/programs/states/ca/Feature%20Stories/San-Francisco-Foodshed-Report.asp

[310] Anderson, M.D. 2007. The Case for Local and Regional Food Marketing, Farm and Food Policy Project issue brief. Northeast-Midwest Institute, Washington, DC. Accessed November 2009 at: http://www.farmandfoodproject.org/index.asp

[311] Brown, C. 2003. "Consumers' Preferences for Locally Produced Food: A Study in Southeast Missouri," American Journal of Alternative Agriculture, Vol. 18, pp. 213-224.

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[313] Selfa, T., and J. Qazi. 2005. "Place, Taste, or Face-to-Face? Understanding Producer-Consumer Networks in 'Local' Food Systems in Washington State," Agriculture and Human Values, Vol. 22, pp. 451-464.

[314] Vogt, R.A., and L.L. Kaiser. 2008. "Still a Time to Act: A Review of Institutional Marketing of Regionally-Grown Food," Agriculture and Human Values, Vol. 25, pp. 241-55.

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[316] Saunders, C., and P. Hayes. 2007. Air Freight Transport of Fresh Fruit and Vegetables, Research Report No. 299, Agribusiness and Economist Research Unit, Lincoln University, Christchurch, New Zealand.

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[319] Blanke, M.M., and B. Burdick. 2005. "Food (miles) for Thought," Environmental Science and Pollution Research, Vol. 12, pp. 125-127.

[320] Coley, D., M. Howard, and M. Winter. 2009. "Local Food, Food Miles and Carbon Emissions: A Comparison of Farm Shop and Mass Distribution Approaches," Food Policy, Vol. 34, pp. 150-155.

[321] Pretty, J.N., et al. 2005. "Farm Costs and Food Miles: An Assessment of the Full Cost of the UK Weekly Food Basket," Food Policy, Vol. 30, pp. 1-19.

[322] Saunders, C., and P. Hayes. 2007. Air Freight Transport of Fresh Fruit and Vegetables, Research Report No. 299, Agribusiness and Economist Research Unit, Lincoln University, Christchurch, New Zealand.

relevant, because transportation accounts for a relatively small share of energy use and emissions in the food system.[323]

- In the United States, agricultural production, processing, and household storage and preparation each account for a larger share of food system energy use than transportation.[324] Total energy use and emissions are affected by differences in inputs used in each segment in the food supply chain,[325] production practices and natural endowments,[326] and crop yields and fertilizer use.[327,328] Finally, Weber and Matthews (2008)[329] suggest that differences in types of food products and diet composition may have important implications for energy use and emissions in the food system.

[323] Weber, C.L., and H.S. Matthews. 2008. "Food-Miles and the Relative Climate Impacts of Food Choices in the United States," Environmental Science and Technology, Vol. 42, pp. 3508-3513.
[324] Heller, M.C., and G.A. Keoleian. 2003. "Assessing the Sustainability of the US Food System: A Life Cycle Perspective," Agricultural Systems, Vol. 76, pp. 1007-1041.
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[329] Weber, C.L., and H.S. Matthews. 2008. "Food-Miles and the Relative Climate Impacts of Food Choices in the United States," Environmental Science and Technology, Vol. 42, pp. 3508-3513.