Integration of Woody Buffers at Three Levels of Spatial Scale in the Urban/Rural Interface in Lincoln – Lancaster County, Nebraska

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ABSTRACT

Integrating a system of planted and natural woody buffers with restored prairie and wetland areas, and other designed open spaces can provide ecosystem services and human amenities at different levels of scale. Strategies for implementing woody buffers need to respond to landowner and community concerns, ecological processes, and long-term impacts of these plantings. Practical examples from Lincoln and Lancaster County, Nebraska illustrate the application of these agroforestry concepts at the county, the individual development, and the private city property scales. At the county scale, the Salt Valley Heritage Greenway or "emerald necklace" has been proposed to follow major streams and short upland connecting areas to form a 50-mile linear buffer entirely around the community. When completed, this network will help the community achieve flood control, water cleansing, and wildlife habitat goals, as well as provide recreation and education for hikers, bikers, bird enthusiasts, and environmental science classes. At the subdivision scale, Cardwell Woods is a 160-acre cluster development site with 50 building lots, and a 37-acre farm dedicated to organic vegetable production that has been zoned in perpetuity for agriculture. Entirely a private venture, this development will be connected to the Heritage Greenway trail system to form part of a larger network of trails and green space that extends south to Kansas and east to Omaha, eventually becoming a segment of the national trails network. At the individual city home scale, a richly forested lot that combines vegetable and fruit production with an urban dwelling demonstrates how significant food production can be incorporated into the built residential environment. These examples illustrate how concepts of agroecology and agroforestry can be incorporated into planning at several levels of spatial scale, providing further insight on the challenges and rewards that are part of the development process.

Keywords: green development, agroforestry, agroecology, multiple goals, landscape functions

Introduction

The rural/urban interface is often an area of potential conflict between people with different goals, activities, and life styles. Even though farmers were one of the first users of the land, the spread of cities in the process that we politely call urbanization or more explicitly denounce as urban sprawl is causing more and more farmland to be converted each year to nonagricultural uses. We are rarely able to contain urban growth in the way

that this is done in many European countries, where centuries of competition for land and frequent shortages of food have created a citizenry that is more aware of the importance of prime agricultural land. Millions of hectares in Europe have been saved for agriculture by careful and restrictive planning (Gardner, 1999). In the U.S. we lack the societal conscience and imperative to grow up rather than out, and in condoning sprawl we convert over 1 million acres of prime farmland each year to other uses (REF?).

At the landscape scale, woody plantings provide one component in a strategy to establish a semi-permanent and effective buffer between urban and rural areas. These planted and managed woody alternatives, called "ecobelts" offer zones of shared ownership and activity that have the potential to ease tensions between urban and rural residents (Schoeneberger et al. 2001). They are discussed in detail, as a logical extension of the concepts of *Working Trees for Agriculture* and *Working Trees for Communities* that have been developed and promoted by the USDA National Center for Agroforestry (http://www.unl.edu/nac). This application of agroforestry at this scale is discussed by describing the Salt Valley Heritage Greenway in Lincoln and Lancaster County.

Much of the development of acreages or ranchettes around the boundaries of our cities is influenced by minimum parcel size on which a new residence is allowed. This may range from 2 or 3 acres up to 20 or 80 acres in some agricultural areas in an attempt to discourage potential buyers and builders. To preserve farmland as well as provide building places in rural environment, there need to be alternatives to the conventional division of land into large and equal parcels around the edge of cities. Many of the same conflicts arise between new residents on acreages and neighbors in production agriculture. At this subdivision scale, a number of legal options are available to the creative planner and developer. Cluster housing in a denser array, leaving some land aside for farming or other open space designation, is described using the Cardwell Woods development near Lincoln as an example. Again, woody vegetation plays a vital role in buffering between two very different activities, providing a greenway that will eventually connect into a larger trails network.

Finally, at the scale of the individual residence, there are ways to integrate food production and natural areas, as an alternative to the traditional mowed homogeneous monoculture of bluegrass lawns. Notable references on intensive food production (Jeavons, 19xx) and on spatial integration of trees with food production (Mollison, 1990) are available, as well as comprehensive guides on how to implement organic gardening systems at the home level (Rodale, 19xx). Although these garden activities are often more benign toward neighbors than the full-scale farm described above, there still may be conflicts over use of compost, noise associated with mulching, or other disturbances to non-gardening neighbors. One example of an individual city lot, about ½ acre in size, is described here as a small-scale application of agroforestry. This example demonstrates the potential for food production – vegetables and fruits – on a normal city lot that also has extensive woody vegetation and the environmental amenities that this setting provides.

These are examples of agroforestry technologies in action, illustrating components of a larger strategy that could be used in creating livable, multi-functional places that are desirable for all residents as well as productive and sustainable with limited external, non-renewable inputs. We could call this an approach for reconnecting people with nature and their food supply through the innovative use of agroforestry technologies for the good of families and communities.

The Nature of Conflict

People in farming and those living on the margins of cities may come into conflict. Here we describe the potential conflicts between a farm and an urban dweller across the fence, recognizing that smaller levels of spatial scale, such as the subdivision or an individual city lot, may present similar challenges but to a lesser degree. The differences in activities and schedules as well as expectations for use of the landscape are brought into clear focus when we observe a dairy farm across the fence or the street from a new subdivision. In many ways, the dust, odors, noise, chemical spray and other normal by-products of farming are not welcome additions to the home environment of the city person who moves to the edge of town or to an acreage. These are all sources of complaints by the home owner, and an increasing pressure from these types of conflicts soon make farming the land a tenuous and unpleasant process. A number of these conflicts and perspectives of city people are summarized in Table 1.

Likewise, the farmer who continues to work the land or care for cattle or hogs on the edge of the city may be plagued by dogs and other pets that enter the fields or corrals and bother livestock, or by curious children who forget to close gates in livestock fences. They may be bothered by leaves or lawn clippings or garbage thrown over into the "empty" field, or even by invaders who like the open space for cross-country skiing, jogging, snowmobiling, or even for dirt biking. Moving farm equipment or livestock from one field to another may impede traffic, creating dangerous situations as well as frustrating delays for all involved. These conflicts and perspectives from the farmer point of view are also summarized in Table 1.

Of course it is possible to resolve some of these conflicts through thoughtful communication, with each side recognizing the points of view of the other and willing to make some accommodation if possible. Unfortunately, many situations are not so easily resolved and often end in hard feelings and litigation. We propose using ecobelts based on agroforestry technologies to create zones of shared ownership, multiple functions, and shared responsibility that is compatible with both rural and urban groups (Schoeneberger, 2001).

In addition to addressing the zone of tension at this interface, there is a larger concern about the disconnect of people in contemporary society from natural areas and from their food supply. In the rapidly globalizing food system, people face an increasingly homogenous food environment in the form of fast food and ubiquitous and undistinguishable supermarkets. This phenomenon has been described in articulate fashion in Schlosser's (2001) *Fast Food Nation* and Nestle's (2002) *Food Politics*. To

Table 1. Sources of Conflict and Different Perspectives of Urban and Rural Residents (adapted from Stokes et al., 1997, and Schoeneberger et al., 2001).

Source of Conflict	*Urban Perspective*	*Rural Perspective*
1. Harmful to homeowners:		
Herbicide drift	Serious danger to lawns and yard plants	Attempt to minimize, but hard to control completely
Insecticide drift	Serious danger to children and pets outside	Attempt to minimize, but part of farming operation
Odors from livestock	Interrupts outdoor activities, even penetrates homes	Accepted part of farm life, and people often don't even notice
Dust drifting from fields	Causes health problems, nuisance to clean up	Common result of tillage activities in field
Insects from cattle, hogs	Serious problem for people outdoors, general nuisance	Accepted part of farm life, controlled if possible
Noise from equipment	Interrupts outdoor activities, hard to sleep at night	Normal part of farming operation, accepted at planting & harvest
Slow-moving/wide equip.	Creates traffic hazards, frustrated drivers	Essential to reach non-contigous fields, no other options for moving
2. Harmful to farmers:		
High-speed traffic	Need to reach work quickly as commuters	Difficult to move and maneuver creates on roads and field entrances
Dogs roaming fields	Normal for dogs to explore and exercise	Nuisance or danger to livestock, may destroy crops , compact soil
Trash over fence	Leaves and grass should be spread as mulch	Concentrated garbage and plastic bags are unwelcome on farm
Equipment security	Kids need to explore and learn on their own	Danger of damage to expensive equipment and facilities
People crossing fields	Desirable open space for hikes, skiing, snowmobiles	Invasion of private property, danger to crops and livestock
Gates left open	Kids will be kids, and need to learn responsibility	Danger of losing livestock on roads, liability issues

explore the impacts and implications of this contemporary situation in food production and consumption, a number of educators and researchers are currently promoting agroecology as the ecology of food systems (Francis et al., 2003).

In this paper we describe some of the practical applications and benefits of woody plantings, including food production and buffering land uses, as key elements in ecobelts that can be effective at the county or landscape scale. At lower levels of spatial scale, we explore a model of an individual residential lot with an urban garden that is part of the larger woody landscape.

Woody Buffers at the Landscape Scale

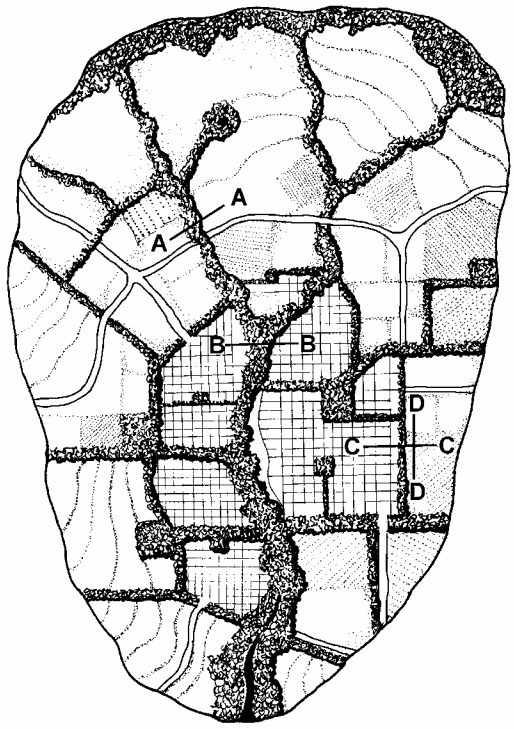
Potentials for using of agroforestry technologies at watershed, community, and neighborhood scales are many. There is ample literature on the use of woody buffers for mitigating the impacts of agriculture, such as soil erosion and pesticide runoff, at field margins, and especially along water courses and near lakes (Schultz et al., 2000). At the interface, they perform both separator and connector functions (Kühn, 2003). Near the rural/urban interface and at the landscape scale, planning for connectivity of open space, wooded areas, and other potential habitat for wildlife and activities of people is best accomplished prior to intensive housing and commercial development. Once urban development is in place, installing woody buffers for multiple functions and activities is difficult and extremely expensive. . Practical applications have been described and illustrated in the "Work*ing Trees*" bulletins of the USDA National Agroforestry Center (1994, 1995, 1998).

There are many lessons to be learned from northern Europe in regard to woody plantings and permanent corridors around cities (Kühn, 2003). These linear zones have served to establish relatively permanent boundaries between farming areas and urban dwellings, and, to a large degree, have discouraged urban growth of cities and beyond agreed-upon limits. Such laws and societal norms contribute to concentration of building and human activities, referred to as the "Compact City" by Williams et al. (2001). Successful greenbelts have been implemented in greater London, Barcelona, Vienna, Budapest, and Berlin (Kühn, 2003). This is an accepted part of society's land-use ethic in these countries, and is not considered an infringement on property rights in contrast to the U.S. Los Angeles and other U.S. cities are obvious prototypes of the free-enterprise, relatively unplanned, and sprawling model that currently prevails and could be called a "post-modern" landscape (Soja, 1995). This may be attributed to the misplaced perception or myth that the U.S. has plenty of land to be developed, particularly in agricultural regions.

It is this concept of using greenways or ecobelts to separate farmlands in the landscape and houses and other development in the cityscape that we apply in this paper (Figure 1) (Rowe, 1991; Schoeneberger et al., 2001, Turner, 1996). The green areas are seen as useful both to separate the two activities and to connect them as well (Kühn, 2003). Linear greenways have been established in the U.S. in conjunction with public parks, highway corridors, abandoned rail lines, and stream or drainage routes (Fabos and Ahern,

Figure 1.

1996). Often these are areas already in the public domain or available to acquire, undesirable for other development, or protected by law from building – such as flood plains. This makes stream corridors an especially desirable place to establish a multiple-use area that can provide for public access as well as protecting waterways. When these areas have the additional function of separating farming activities from urban dwellings it becomes a win-win-win situation.



Here we describe one such linear park area that is partly in place and planned to extend around the community of Lincoln, Nebraska, illustrating an application of the woody buffer and agroforestry model at the landscape level.

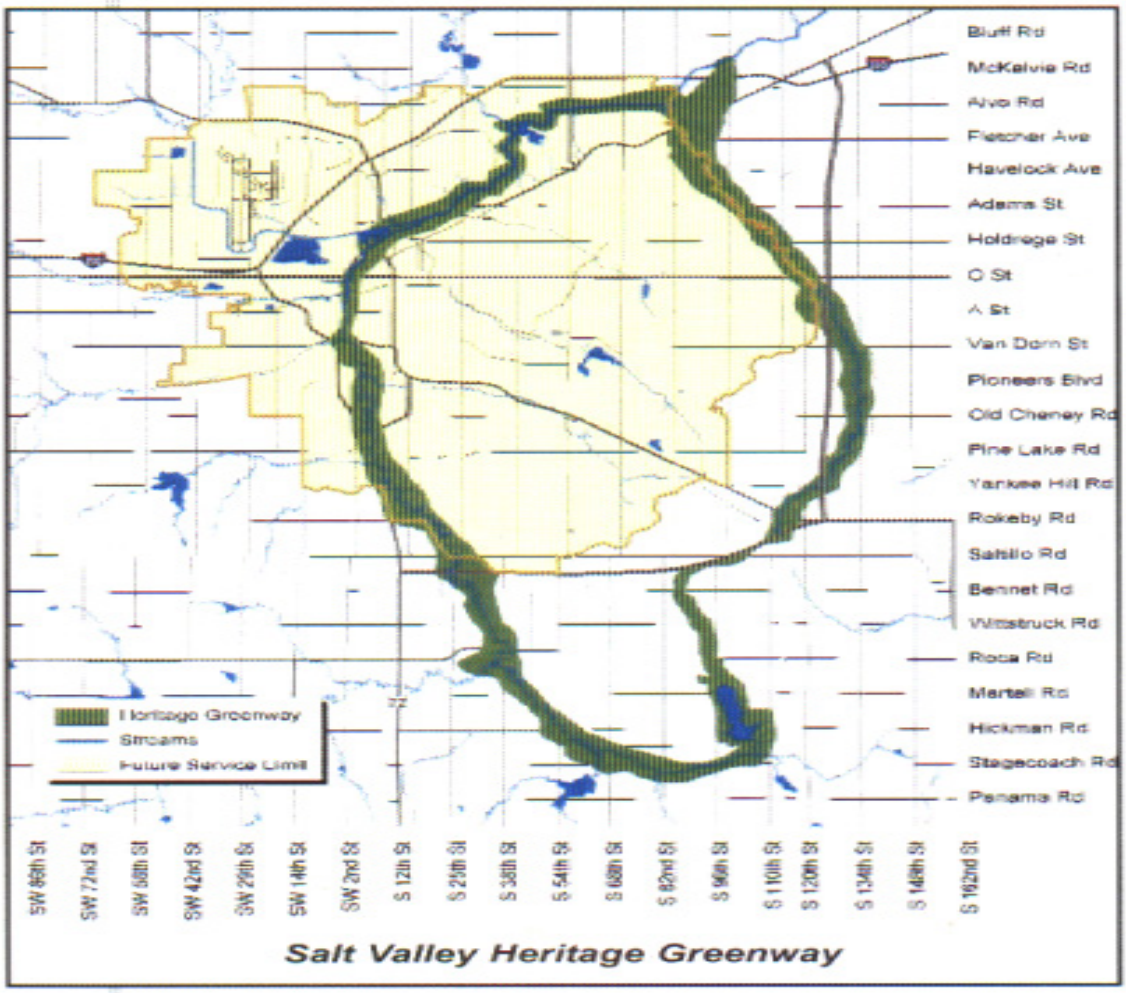
Case Study I: Salt Valley Heritage Greenway: a County-Scale Model

Salt Creek, a tributary to the Platte and Missouri Rivers, runs in a northerly direction near what was originally the west limits of Lincoln, and then in an east-north-easterly direction to join the Platte. The saline wetlands along this creek were an early attraction to Native Americans well before the European settlement of the 1860s. Much of the creek's floodplain has been preserved from building, although creative zoning has allowed developers to fill and build in some areas that are susceptible to 100-year flood events. A series of dams has been built during the past 40 years to reduce chances of flooding, and one of these dams will become important node in the eventual green belt that will surround Lincoln.

Wilderness Park was established in 1972 as a relatively undeveloped habitat area that stretches five miles along Salt Creek from the southwest corner of Lincoln into what was then countryside. The park has trails for hikers, bikers and horse riders, picnic grounds, and group day-use areas. Over 95% of the park is preserved in its natural state as wildlife habitat, and the park is home to over 200 species of plants, over 100 species of birds, 24 species of amphibians and reptiles, 42 species of mammals, and 19 fish species (Case, 1990). There are three distinct woodland communities: burr oak/hackberry/bitternut, burr oak/elm/honey locust, and silver maple/cottonwood. With the exception of a new highway built through about 35 acres of the park in 1985, the wild nature of this area has been maintained fairly well, though development now encroaches on the boundaries with a new high school, library, baseball fields, an industrial park, and homes crowding the eastern edge of the park. This 6 1/2-mile corridor of 1475 acres inspires a vision for a 50-mile perimeter park and link that is now in the planning stage (Lincoln – Lancaster Comprehensive Plan, 2002).

The Salt Valley Heritage Greenway will eventually extend to the south more than 5 miles to the village of Hickman and 2 ½ east to Wagon Train Lake (see Figure 2). It will also follow the Salt Creek channel north through Lincoln and circle the north side to town to where Stevens Creek joins from the south. The greenway will follow this stream south for some 12 miles, and a short 2-mile overland link will connect this side to Wagon Train Lake. The entire 50-mile greenway will eventually provide public access through trails to a unique natural habitat and boundary around the city. Although not a boundary that prevents development in the sense of the greenbelts around European cities, this does provide a model for private/public collaboration in establishing a natural area that is accessible to the Lincoln community.

Figure 2.



The greenway will provide multiple opportunities for public use and education, including hiking and biking trails, equestrian paths in part of the park, bird watching opportunities, day use for environmental education and access by school classes, and other types of special programs. Yet this will not happen until a number of challenges can be overcome. These are described here because they represent the types of resistance and problems that

could be faced at other planning situations. Obviously there is a need for substantial funding from public or private sources to make such a park a reality. Purchase of land outright will be necessary for some parcels for development for parking, public facilities, and access roads to the park. While some of this is essential, it is better financially to think in terms of conservation easements on agricultural land including the right of public access to some portion of the greenway. In addition to reducing the financial burden, this places the maintenance of much of the land in private hands, and provides a buffer of agricultural land for the rest of the waterway and public space. When development rights are purchased, there can be stipulations on the types of farming that are allowed (such as organic farming) and the right of public access to the trails. There is also a need in many areas to overcome concerns by landowners about people trespassing on their land, disrupting agricultural cropping or livestock activities, or leaving trash along the public access areas. Experience has shown that this is much less of a threat than usually perceived by landowners without prior exposure to bike paths or nature trails. The types of people who frequent such natural areas are not the types who will discard garbage, and generally have respect for others' property. One of the best ways to convince recalcitrant landowners has been to bring an invited speaker from another place who is also a farmer and landowner, and who can provide a personal experience about the success of a bike or hiking corridor.

Woody Plantings at the Subdivision Scale

While some conventional housing developments make use of existing trees if possible, many clear the area completely for ease of earthwork and simplifying construction. However, with careful planning and design, housing projects can take advantage of existing vegetation. There is ample evidence that large trees increase the value of residential property (Anderson and Cordell, 1988), and to establish new trees requires a long time for young trees to grow or prohibitive expense for planting larger trees.

Many current subdivisions use creative layout of streets, lot design and house placement to establish an attractive and safe place for people to create their homes. When there is adjacent green space or a watercourse, this is incorporated into the design and lots along these features demand higher prices than those without such an amenity (NPS, 1995). When the open space is occupied by an active farming operation, however, some of the same conflicts described above at the urban/rural interface may prevail. This could certainly be the case of an acreage that is next to or surrounded by farm ground. Creative developers have found ways to combine the two activities, using existing and planted tree buffer areas between the two types of land use. One such development of a quarter section near Lincoln has used a cluster design and designation of just over 2% of the area as permanent farmland.

Case Study II: Cardwell Woods and Shadow Brook Farm: Private Land Developments

An example of how ecological functions can be preserved or restored at the subdivision scale is provided by the residential development called Cardwell Woods in southwest Lincoln, which incorporates an agricultural operation called Shadow Brook Farm. The

developer Lyle Loth took advantage of the clustering option available in Lancaster County that provides opportunity to place houses closer together with less than the normally required minimum lot size in this zoning category. In exchange, a 37-acre farm was established as a part of the 160-acre development, which is to be devoted in perpetuity to farming. Loth's son Kevin and daughter-in-law Charuth and three young children now live in the original farmhouse on the property and have developed an organic farm that supports them as well as a number of seasonal laborers who are often student interns learning the business of direct marketing vegetables.

Starting on a small scale, this farm now has two acres of asparagus, one conventional greenhouse for starting transplants, and three hoop houses for indoor production to extend the growing and marketing season. Based on their vegetable growing experience at U.C. Santa Cruz and on a private farm in the Salinas Valley, the Loths are now operating in the more challenging continental climate of Nebraska and producing more than 50 species of vegetables, flowers and herbs. To further diversify the farm, a small flock of different poultry species, goats, and dwarf beef cattle are consuming some of the plant residues and speeding the cycling of nutrients. In the future these enterprises will be expanded to provide a wider range of products to their customers.

The major outlets for products are the farmers' markets once each week in Lincoln and Omaha where Shadow Brook Farm is known for its signature product, mixed salad greens. Their sales tables always have a line waiting at 8 am when the whistle blows, and often the queue of those anxious to buy their quality products may be five to ten people deep. In Lincoln, it is not unusual to have four people waiting on customers just to keep up with demand. The second most important sales outlet is their new farm sales building located on the farm. Using a CSA-type sales arrangement to extend the season with early greens before the farmers' market opens for the spring has provided an additional source of income. In the future, they would like to concentrate on sales from the farm, to reduce the travel and transactions costs and keep them closer to the family.

Existing woody vegetation on the farm and near the farmstead have been integral to the implementation of an intensive vegetable farm. The current woody buffers serve as a windbreaks and add enhances the "farmscape" making it more appealing to visitors. Future plans are in the works for commercially productive tree plantings including an orchard, decorative woody florals, and other enhancement of the property to help attract visitors. Since both the development and the farm are adjacent to the Cardwell Branch of Salt Creek, a trail has been established through the quarter section property, and this will eventually connect with Wilderness Park trails and the Salt Valley Heritage Greenway.

Woody Plantings at the Individual Homesite Scale.

There are numerous publications on home gardens, but few focus on the use of agroforestry technologies, the integration of woody perennials with vegetable production by individuals. This is a logical level at which to apply the principles of Agroforestry because of the potential of individual homeowners to invest in landscaping that has multiple function – esthetics, shade for the house and outside activities, and production of

food. Most of the financial constraints that face a commercial farm near the city, and the large costs faced by a community trying to establish large-scale new plantings are not the same at the homesite scale. There are numerous books on home gardening, of course, but we think this concept could be applied nicely to the individual home level. One example in a case study from Lincoln, Nebraska follows.

Case Study III. Urban Garden in Lincoln

At the spatial scale of the individual home site, a half-acre lot in the city of Lincoln, illustrates the application of agroforestry principles in vegetable and berry production right in the city. Fortunate to have a triple city lot due to presence of an original farmhouse, the half-acre property of Barb and Charles Francis has an intensive area for vegetable production (about 1800 sq. ft.), berry production (500 sq. ft.) and extensive compost pile (200 sq. ft.). Irrigation when needed is accomplished with soaker hoses that are covered with soil or mulch to reduce evaporation in the often stressful summer weather. They are gradually removing grassed areas and replacing them with intensive vegetable beds to expand the garden, and placing fruit trees in strategic spots. They have three very large trees (maple and oak) that shade the entire dwelling, and numerous other trees on the property (scotch pine, blue spruce, cedar, tulip, redbud, crabapple, and amber maple). Extending the garden area must be done without compromising the cooling effects of these trees on the house and the screening of the property from the busy street that passes in front.

The soil fertility has gradually been improved over the 25 years through the addition of compost generated from prunings and leaves from the property as well as leaves and grass clippings from neighboring lots. Insect and other pest problems, especially rabbits, have been avoided by using multiple planting dates and several varieties of each vegetable, and placing low rabbit fences around the planted areas. Organic methods have been used to grow a wide range of vegetables. Volunteer plants are encouraged each spring, including garlic, dill, potato, tomato, and tomatillo, as well as established perennials such as rhubarb and red and black raspberries. Most successful vegetables planted each spring include tomato, potato, lettuce, peas, green beans, tomatillo, chard, spinach, radish, arugula, kale, cilantro, parsley, peppers, eggplant, onion, zucchini, winter squash, and cucumber. The owners estimate the value of this produce, consumed at home and given to neighbors, family and the food bank, to be in excess of $1,000 per summer. This would classify the property as a farm, if these products were sold for that amount. The Barb and Charles consider this to be an appropriate use of land, good exercise, a healthy and secure source of food, and a fun activity that they enjoy doing together. They produce approximately 20% of their year's food from this urban garden, with many items canned or frozen for use through the winter months.

Conclusions

The multiple functions of woody plantings have been well documented in research, particularly at smaller spatial scales. A significant challenge lies in integrating woody buffer functions at different scales to provide ecosystem services and human amenities to

individual landowners and communities. Strategies for implementing woody buffers need to respond to landowner and community concerns, ecological processes, and long-term impacts of these plantings.

At the landscape scale, buffers need to address broad ecological functions such as flood attenuation, water quality protection and enhancement, and habitat and movement corridors for plants and animals while offering amenities like recreation and separation of land-uses. Achieving this vision requires extensive community participation and support through a planning process to identify suitable locations for these buffers and means to acquire them. At the subdivision scale, appropriate storm-water management, minimization of urban heat islands, and filtering of noise and pollution are issues that appropriately designed and managed buffers can address. Flexible zoning measures and development incentives are some the keys for encouraging woody buffers in subdivisions. At the site scale, woody buffers or plantings can modify microclimates and create habitat, while providing suitable food production areas. Through a comprehensive multi-scale approach, the many benefits of woody buffers can be realized.

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