V. Consequences for Farming

Through the entire process of development, farming coexists with development and adapts, however uneasily, in the shadow of the city. Settlement patterns that create low-density development and fragmentation across rural landscapes have both negative and positive consequences for agriculture. Increasing population and employment provide some opportunities for farms, but also create problems.

Agriculture: Farming in the City's Shadow

Large and growing areas of U.S. agriculture are influenced by proximity to urbanization and concentrations of population brought about by growth. Metropolitan Statistical Areas (MSAs), defined by the Bureau of the Census, contain 20 percent of U.S. land area and 80 percent of the U.S. population (Bureau of the Census, GARMS, 2000). Nationally, farms in metropolitan areas are an increasingly important component of U.S. agriculture. In 1997, they made up a third of all farms and controlled 39 percent of farm assets (table 3). Eighteen percent of farmland operated was located in metro areas in 1997, roughly proportional to the total land in metro areas (Barnard and Heimlich, 1993; Heimlich and Barnard, 1992, 1997; Hoppe and Korb, 2000). The count of farms excludes service firms, such as horse boarders and landscape services that are not directly involved in agricultural production, but that contribute to open space and economic activity.

As urbanization proceeds, landowners may seek enterprises and markets that offer returns to land more commensurate with those from development, in part to offset the higher property taxes that are incurred as land prices rise to reflect the potential for future nonagricul-

Table 3—Metro and nonmetro farm characteristics, United States, 1991 and 1997

Characteristic	Metro				Nonmetro	Total
	Recreational	Adaptive	Traditional	Subtotal		
			Number			
Number of farms, 1991	372,689	97,024	226,704	696,416	1,390,607	2,087,023
Number of farms, 1997	283,776	74,522	199,569	557,867	1,181,349	1,739,216
			Thousand acres			
Acres owned, 1991	23,107	12,613	55,996	91,927	417,182	509,109
Acres operated, 1991	33,542	24,741	142,370	200,568	1,090,236	1,290,804
Acres operated, 1997	22,675	13,894	123,323	159,892	733,031	892,923
			Million dollars			
Sales of agr. products, 1991	910	18,877	17,647	36,900	69,975	106,875
Net cash farm income, 1991	-1,813	4,190	2,752	4,993	13,866	18,858
Total off-farm income, 1991	16,708	4,564	2,102	27,883	38,301	66,185
Assets, 1991	92,026	90,537	129,420	311,982	489,434	801,416
Net worth, 1991	85,251	79,328	116,207	280,786	424,312	705,098
Sales of agr. products, 1997	996	27,652	38,055	66,703	130,162	196,865
Sales per acre operated, 1991	27	763	124	184	64	83
Sales per acre operated, 1997	44	1,990	309	417	178	220
			Percent of all farms			
Number of farms, 1991	18	5	11	33	67	100
Number of farms, 1997	16	4	11	32	68	100
Acres owned, 1991	5	2	11	18	82	100
Acres operated, 1991	3	2	11	16	84	100
Acres operated, 1997	3	2	14	18	82	100
Sales of agr. products, 1991	1	18	17	35	65	100
Sales of agr. products, 1997	1	14	19	34	66	100
Net cash farm income, 1991	-10	22	15	26	74	100
Total off-farm income, 1991	25	7	3	42	58	100
Assets, 1991	11	11	16	39	61	100
Net worth, 1991	12	11	16	40	60	100

Sources: 1991 data from Heimlich and Barnard, 1996; 1997 data from Hoppe and Korb, 2000

tural development. Initially, this may involve innovative marketing techniques, such as U-pick, community agriculture, contracts with restaurants, or farmers' markets. At some point, successfully adapting farmers may become more general rural entrepreneurs, not limiting themselves to farm activities at all. Landowners may also sell off less productive woodlots and pastureland, concentrating on more intensive production on remaining cropland. Other farmers attempt to maintain traditional crops and practices, some merely waiting for the perceived inevitable sale for development. Some farms simply go out of business and the land remains idle, or the land is divided and sold to hobby farmers, recreational farmers, or part-time farmers whose primary use of the land is as a residence.

Many of the economic changes faced by farmers on the urban fringe have a dual-edged impact on agriculture, bringing pressures to adapt, while simultaneously offering opportunities and rewards for doing so. On the down side, proximity to urban areas can present obstacles to profitable farming operations.

Positive Impacts on Farming from Urbanization

- Proximity to urban centers may provide a larger pool of seasonal or part-time labor that is especially important to harvest high-value crops. One reason metro farms can adopt high-value crops is because local sources of labor are available at peak periods (Jordon, 1989).

- Greater off-farm employment opportunities for the farmer or his/her family may help support the farming operation (Stallman and Alwang, 1991). Off-farm employment can also provide a transition to part-time farming, particularly if enterprise changes are undertaken that reduce full-time labor needs on the farm. Opportunities from urban employment run in both directions. People in urbanizing areas may work part-time on the farm or start recreational farms that eventually develop into full-time, part-time, or retirement businesses.

- Nationally, 90 percent of average farm household income was from off-farm sources in 1999, including part-time employment, spousal income, and other business income. The percentage in recent years has varied from 83 to 90 percent. Government payments are part of gross cash income, and cannot be compared to net farm income or household income. Only 36 percent of farms receive government payments, and the percentage is lower in metro areas (Sommer et al., 1998, table 31).

- Expanding populations provide opportunities for farmers to grow new crops and to market them in new ways, such as through farmers' markets (figure 18; Price and Harris, 2000). High-value crops, such as fresh fruits and vegetables, can be sold through restaurants and gourmet grocery outlets or directly to consumers in roadside stands or U-pick operations (see box, "Urbanization and Vegetable Production"). U-pick farms may combine produce sales with value-added products like dried herbs or flowers, jams and jellies, homemade breads or pastries, or other farm-related products. Recreational aspects of U-pick operations, such as hayrides, picnics, farm-pond fishing, and special holiday features, such as old-fashioned Halloween or Christmas activities, may also add value to urban customers' purchases. Horse boarding, breeding, and training facilities, cattle-breeding operations or other specialty livestock operations may replace more extensive dairy farms and cow-calf operations.

Negative Impacts on Farming from Urbanization

- Suburban neighbors' complaints about farm odors and chemical spraying may force farmers to turn to enterprises that produce fewer negative side effects. Some of the alternatives will be more profitable and some will be less (Reynnells, 1987; Van Driesche et al., 1987).

- Conflicts can arise between growers and new suburban neighbors over early morning noise, and increased traffic can hinder farmers' ability to move their equipment along overcrowded rural roads being used as commuter routes.

- Markets for traditional dairy products or field crops may be reduced, as milk-collection routes are curtailed and grain elevators go out of business. In some areas, farm input suppliers, machinery dealers, and other forms of agricultural support may decline.

- Real estate taxes may rise as land prices rise to reflect the potential for nonfarm development.

- Growers may face increased pressure from water- and land-use restrictions.

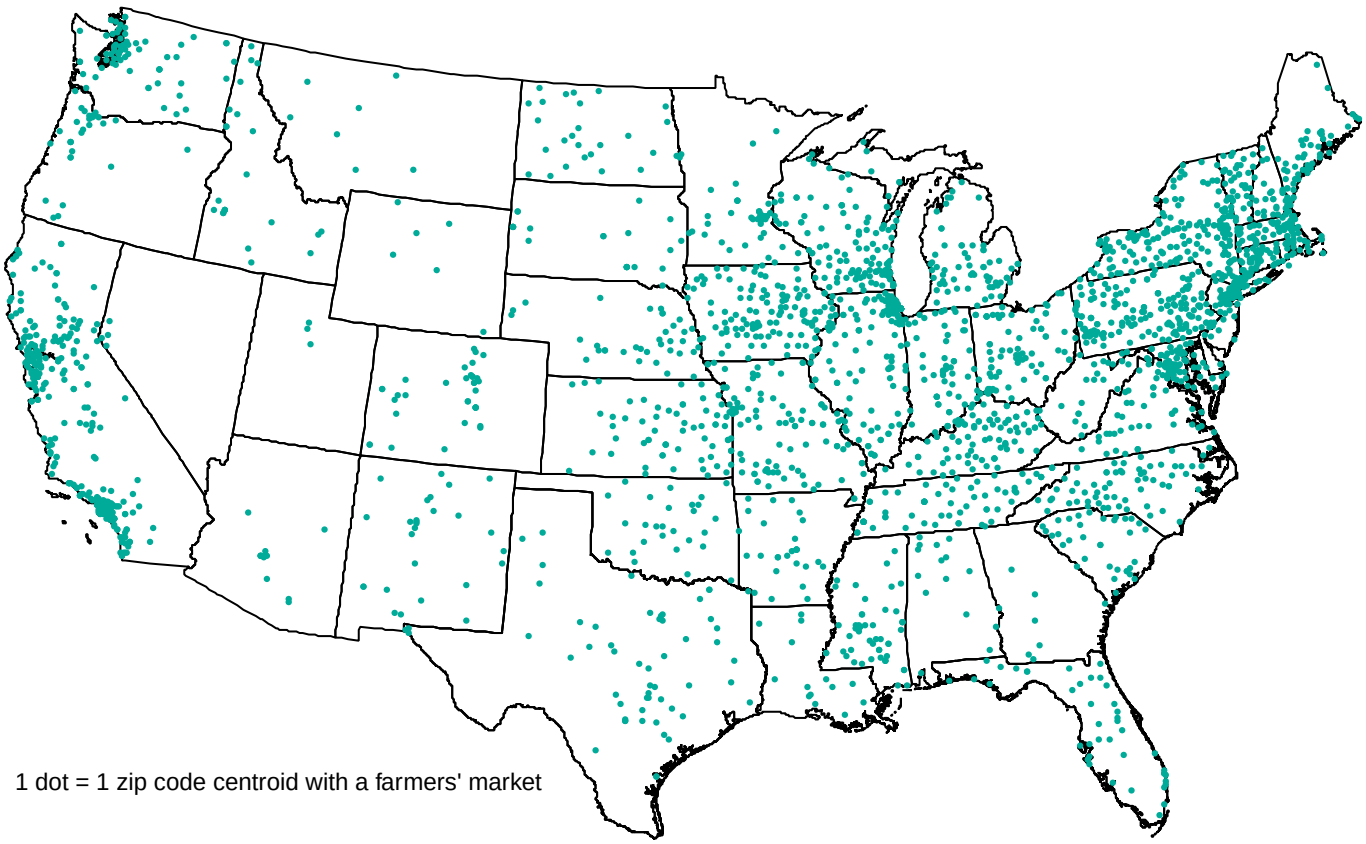
- Farms may face deteriorating crop yields from urban smog, theft, and vandalism.

The dynamic forces of urbanization create an urban fringe in which a variety of farm types coexist, reflecting different paths that farms have taken in adapting to urban influence (figure 19; see box "Categorizing Metro Farms" for methods). These changes occur primarily through changes in the product and input markets in which farmers buy and sell, and through the actions of local government institutions, which by law and tradition exercise control over property taxes and land use (Heimlich and Brooks, 1989). Farms in metro areas are generally smaller, produce more per acre, have more diverse enterprises, and are more focused on high-value production than nonmetro farms (Barnard and Heimlich, 1993; Heimlich and Brooks, 1989; Heimlich 1988; Heimlich and Barnard, 1992, 1997; Hoppe and Korb, 2000). Metro agriculture is characterized by a relatively large group of recreational farmers who are availing themselves of opportunities in both farm and nonfarm pursuits, a smaller group of more adaptive farmers who have accommodated their farming operation to an urban environment, and a residual group of more traditional farmers who are trying to survive in the face of urbanization (see box, "Categorizing Metro Farms").

Recreational farms in metro areas accounted for 16-18 percent of U.S. farms, but contributed only 1 percent to aggregate U.S. sales of agricultural products. Within metro areas, recreational farms accounted for 51-54 percent of farms and controlled 29-30 percent of farm sector assets and equity and 14-17 percent of the land operated. These recreational farms have little viability as economic enterprises and are essentially a consumption activity that will become increasingly expensive for their owners as urban development continues. Traditional farms made up a third of metro farms, operated 71-77 percent of metro farm acreage, and controlled more than 40 percent of assets, sales, and net cash farm income. When a farm hobby is no longer fun, or the farming tradition finally yields too little profit to continue, development may soon follow.

Adaptive farms accounted for 13-14 percent of metro farms and 9-12 percent of metro farm acreage operated,

Figure 18
Distribution of farmers' markets



Source: Price and Harris, 2000.

but they controlled more than proportional shares of metro farm sales, assets, and net cash farm income. These are the farms that have a better chance of continuing in an urbanizing setting.

Survival of Farm Types in Metropolitan Areas

Longitudinal data from the 1997 Census of Agriculture were used to follow farms existing in 1978 through time (Hoppe and Korb, 2000; see box "The 1997 Census of Agriculture Longitudinal File"). A farm was defined to be "out of business" in a given year if it had no sales that year, either because it had ceased operation or had been sold to another farm. As shown in figures 20 and 21, the share of farms that went out of business be-tween 1978 and 1997 varied widely among the farm categories.

Virtually all the farms classified as recreational in 1978 were out of business by 1997, regardless of geographic location. Data from the 1995 Farm Costs and Returns Survey (FCRS) indicate that small farm operators who

Urbanization and Vegetable Production

As the United States continues to urbanize, conflicts between agricultural and nonagricultural uses of land will intensify. These changes are particularly important for the vegetable industry. The agronomic characteristics of land that are key for vegetable production (warm temperatures, especially in the winter; an adequate supply of water; and level, well-drained soils) are also characteristics that are highly valued for urban development. Many of the major national production centers for vegetables and melons are located in areas subject to intense pressure from urban development. A significant percentage of U.S. vegetable acreage (61 percent) is located in metropolitan areas.

Vegetable and melon production tends to be geographically concentrated in California, Florida, Texas, and Arizona. This regionalization of production is even more acute during the winter months, with domestic production largely confined to a relatively few counties within these four States. But, these States also rank high in population and projected population growth. The Bureau of the Census projects 45- to 55-percent increases in population in these States between 1995 and 2025. Seven of the top 10 vegetable-producing counties are in California. California's Monterey County is the Nation's top vegetable area, with 6 percent of the harvested area. The fertile Salinas Valley, which has been called the world's salad bowl because of the concentrated production of green vegetables, is located in Monterey County. Does impending population growth pose a risk to domestic vegetable and melon production?

The interface between vegetable production and development in urban fringe counties sets up competition for the use of farmland that has both negative and positive impacts on vegetable acreage. Urban uses generate higher returns per acre than do agricultural uses, with the consequence that urban uses outbid agricultural uses and farmland is directly converted to developed uses. But, as urbanization proceeds, changes in the local economic environment for agriculture act in a countervailing manner to increase the suitability of urban-influenced farmland for vegetable production. First, population growth in nearby urban areas creates increased demand for locally grown fresh vegetables. This effect implies that there is an economic advantage for production located close to concentrations of consumers. Second, relative to other agricultural products, many vegetables produce high returns per acre, creating a comparative advantage for vegetable production in urbanizing areas. Substitution of vegetable production for other less intensive enterprises may cause vegetable production to increase, at least temporarily, in many urbanizing areas. The counterintuitive result is that as urbanization proceeds, acres devoted to vegetable production may actually increase. This finding is consistent with research reported elsewhere (see Barnard and Lucier; Lopez, Adelaja, and Andrews, 1988; Heimlich and Barnard; Hart; Vesterby and Krupa, 1993).

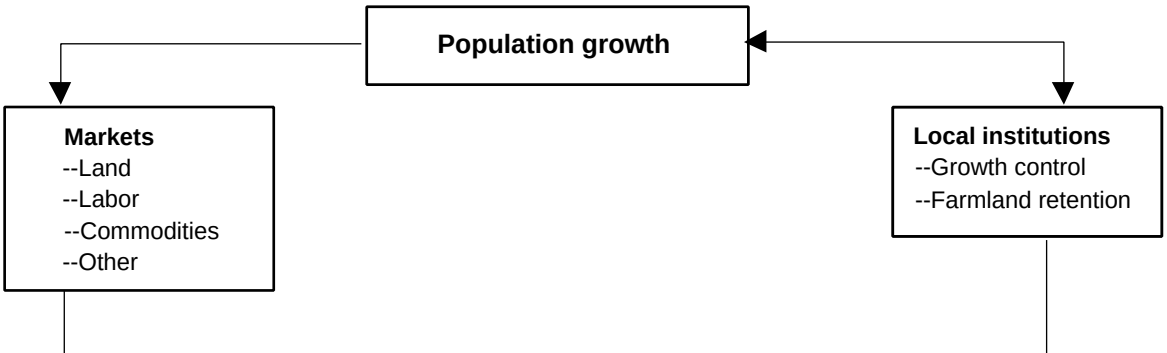
Urbanization often has negative impacts upon agricultural production, including vegetable production. In urban/agricultural fringes, conflicts between growers and new suburban neighbors occur with respect to issues such as farm odors, early morning noise, pesticide applications, and hindrance of farmers' ability to move farm equipment along overcrowded rural roads being used as commuter routes. Growers also face increased pressure from water- and land-use restriction. Some farms on the urban fringe face crop-yield deterioration from urban smog, theft, and vandalism.

Land used for other crops dwarfs that needed for vegetables and melons—all vegetable production in the United States occurs on less than 1 percent of total cropland. In 1992, the United States harvested 3.8 million acres of vegetables—about 0.9 percent of total cropland. There is wide geographic dispersion of the top vegetable counties, indicating that many areas of the United States can produce vegetables on a commercial scale—although only a select few can do so year round. The top 100 vegetable counties, which are dispersed across 20 States, account for only 62 percent of vegetable acres. In addition, since 1959, more than 40 counties have moved ***into*** the top-100 list. The countervailing pressures of urbanization mean that vegetable production is the last to go, and its high value means that when urban pressures prevail, vegetable production moves beyond the urban fringe, to wait for the next burst of development, if it can.

do not report farming as their occupation gave "a rural lifestyle" as their highest-ranking goal from farming (Hoppe, 2000). In contrast, farmers depending on farming for substantial portions of their income reported survival of the farm as their most important goal. However, more than three-fourths of the 1978 traditional farms had also left business by 1997. Again, there was little variation by geographic location.

Adaptive farms were much more likely than either recreational or traditional farms to survive the full two decades. In the case of adaptive farms, the percentage leaving business varied substantially by geographic area, with the percentage declining with distance from the metro core. Adaptive farms may have a survival advantage over recreational or traditional farms in urban or metro areas, but they survive better where there is less development.

Figure 19
Conceptual model of agricultural adaptation to urbanization



Metropolitan farm types

	Recreational	Adaptive	Traditional
Farm size	Very small	Small	Large
Intensity			
Land	Very low	High	Low
Labor	High	High	Low
Capital	High	High	High
Inputs	Very low	Very high	High
Enterprises	Either	High-value	Conventional
Occupation	Nonfarmer	Either	Farmer

Source: Heimlich and Brooks, 1989.

Categorizing Metro Farms

Each farm was grouped into one of three categories in each census year, using the recreational, adaptive, and traditional groups from Heimlich and Barnard (1992). The definitions developed in the earlier study could not be exactly duplicated because the longitudinal Census data used here are much less detailed than the data used earlier. The farm categories are:

Recreational—Includes any farm with sales less than $10,000, defined in 1997 constant dollars. Farms with sales this low are very small and have little ability to generate income for the farm family. Income from off-farm sources is common across farms today, but it makes up a large portion of total income for these farm households. Dollar values for earlier years are adjusted with the implicit GDP deflator.

Adaptive—Includes farms that produce relatively high-value products, with sales of $10,000 or more and having sales of more than $500 per acre of land. Specializing in high-value products allows these farms to adjust to increasing land prices, population density, and continuing conversion of local agricultural land to nonfarm uses.

An alternative criterion is that the farm specializes in high-value commodities, with those commodities accounting for more than 50 percent of the farm's sales.

Traditional—All other farms fall in the traditional group. However, farms with sales greater than $500 per acre were classified as traditional if they did not have high-value specializations. Traditional farms are most likely to remain in nonmetro counties, where there is less competition for land and labor and fewer off-farm job opportunities.

Other classifications of farms have been devised (see for example, Hoppe et al., 1999). However, the classification presented here focuses on farmers' reactions to development.

Although the 20-year survival rates were fairly low for all farm categories in the metro counties, survival rates for farms were similar to those for businesses in general (Hoppe and Korb). Furthermore, the fact that individual farms may go out of business does not mean that farms and their land disappear into subdivisions. Metro areas experience substantial entry of new farm businesses (figure 21).

The different types of farms and the turnover in farms have implications for metro areas' attempts to preserve open space held by farms. Adaptive farms are the most likely to survive as farms. Programs to preserve farmland through commercial farming may have minimal impact on traditional and recreational farms, because these farms have difficulties generating enough revenues to resist development. The turnover in farms of all types suggests that land-use planners concerned with maintaining viable farm businesses will need to monitor sales of land among farmers as well as sales between farmers and developers.

The 1997 Census of Agriculture Longitudinal File

This data set contains information on individual farms from the 1978, 1982, 1987, 1992, and 1997 Censuses of Agriculture. Data from each census were merged for individual farms. Thus, individual farms can be followed for a 20-year period. Variables measured in dollar terms are defined in 1997 dollars. Values for earlier years are adjusted with the implicit GDP deflator.

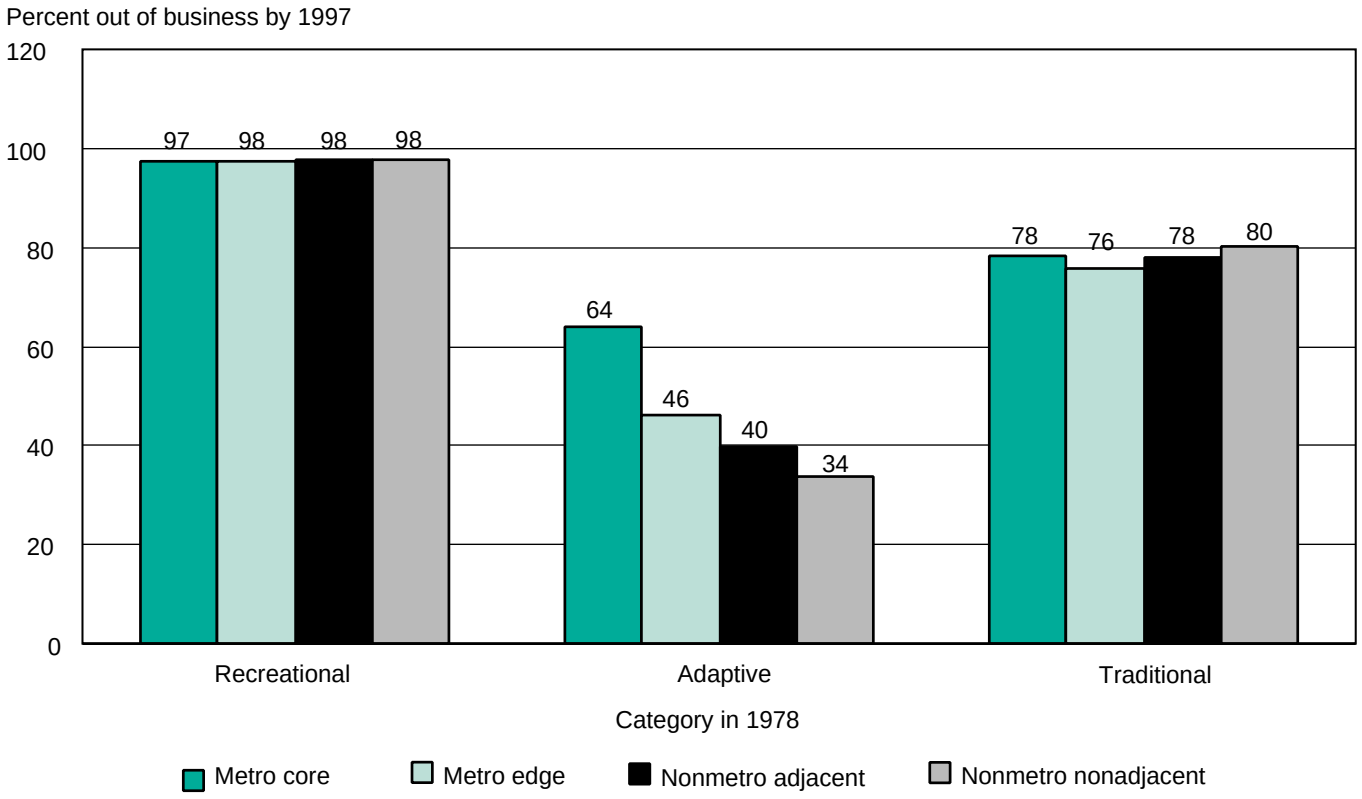
A farm is defined to be "out of business" in a given year if it had no sales that year. Farms are defined in terms of the operator, not the parcel of land. Consider a farmer who sells his farm to a new operator just beginning to farm. The file shows one farm going out of business (the farm operated by the exiting farmer) and one farm beginning business (the farm of the new operator). If the exiting farmer sold his farm to an established farmer, the file would show one farm going out of business and one farm continuing in business.

Working Landscapes and Rural Amenities

At the extreme, urbanization brings about the local extinction of farming as an economic activity and as a working landscape. However, the transition from rural to urban is not entirely negative, since some farming activities benefit from greater proximity to urban population. Growth makes this transition more difficult than it might otherwise be because the future pattern is more haphazard and less certain than development guided through planned growth.

Farming activities adapted to urbanizing areas can provide rural amenities that are profitable for the landowners and operators, and desirable for the surrounding population. Inevitably, these activities differ from those that went before, and they may not be embraced by the farm's prior owners or operators. Different kinds of

Figure 20
Farms in 1978 out of business by 1997, by farm category



Source: Hoppe and Korb, 2000 from USDA, ERS and NASS, 1997 Census of Agriculture Longitudinal File.

products and services are produced, in different ways, for different markets that are better suited to an urbanizing environment. How permanent these adaptations can be in the face of development, and how much and in what ways public support for these amenities should be provided are questions that cannot yet be answered.

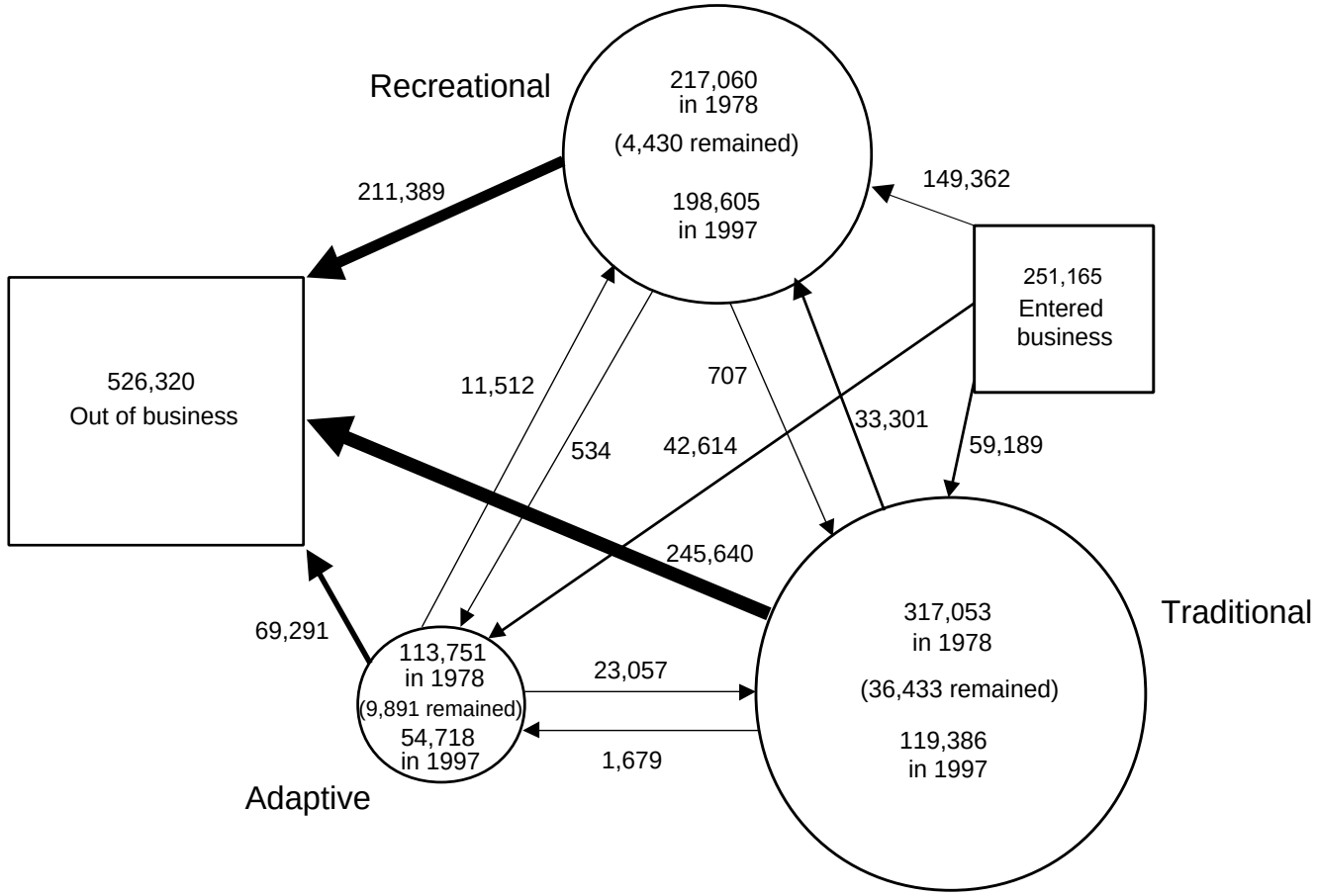
Farmland encompasses cropland, pasture, range, and farm woodlots, all of which serve some function in a working farm and also provide rural amenities. Even if active farming as an economic activity is no longer profitable, conserving rural land uses may continue to provide rural amenities that justify protection programs. Other rural landscapes that may never have been in farms (forestland, wetlands, barrens, etc.) or to which abandoned farmland may revert may also provide rural amenities worth preserving.

Benefits of Farmland and Open Space

A question for thoughtful consumers and public policy officials is: Do those who move to new suburban or exurban developments actually get what they paid for? That is, does moving into the "country" ultimately destroy the good things that prompt that move? In the words of the National Governor's Association, "In the context of traditional growth patterns, the desire to live the 'American Dream' and purchase a single-family home on a large lot in a formerly open space can produce a negative outcome for society as a whole." (Hirschhorn, 2000, p. 55). Can the potential benefits of lower density development, which accrue from a better relationship between home place and work place, actually come about without planning communities? What benefits of rural landscapes do we destroy by growing out into previously undeveloped rural areas?

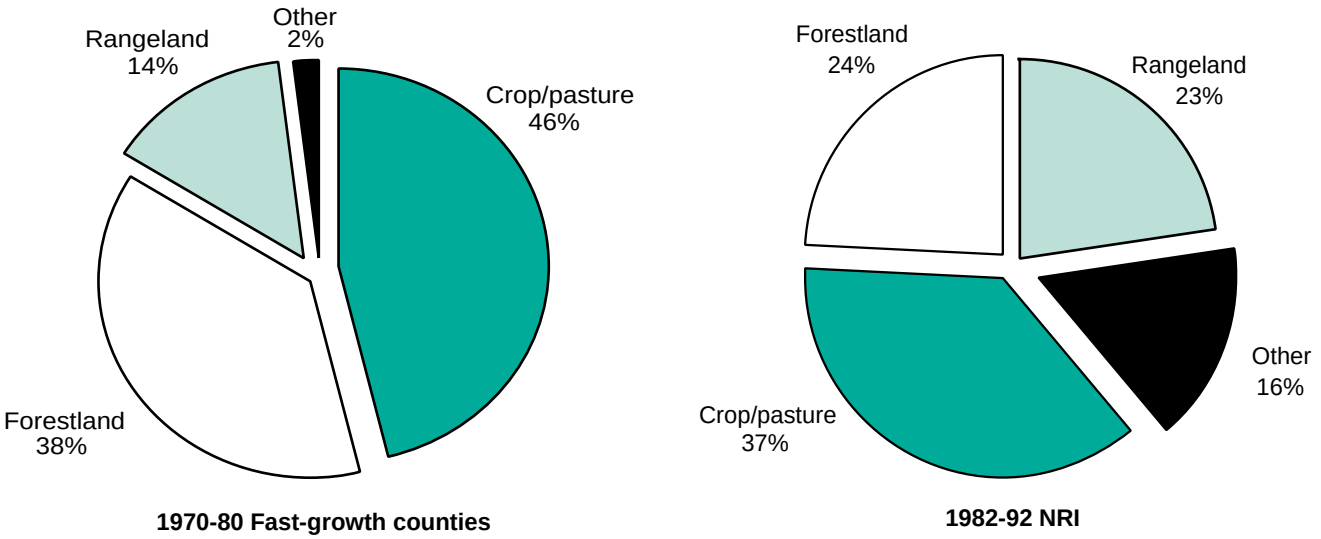
It is important to consider what is sacrificed for development. Rural land is more than "vacant" building lots waiting for development. It is a working landscape of functioning farms and forests that serve both economic and environmental purposes. In a study of rapidly growing counties during the 1970's, cropland and pasture provided about a third of the area for urban expansion, and rangeland and forestland each provided about a fourth (Vesterby, Heimlich and Krupa, 1994; figure 22). About a sixth of urbanized land came from other

Figure 21
Transitions between farm types, metro farms, 1978-97



Sizes of circles, boxes, and arrows proportional to farm numbers.
Source: ERS analysis of 1978 to 1997 Census of Agriculture microdata, Hoppe and Korb, 2000.

Figure 22
Composition of land use change in urbanizing areas, 1970's and 1980's



Sources: Vesterby et al.,1994; National Resources Inventory.

land uses, including vacant land whose previous use could not be determined. Based on the NRI data for urban and built-up land for the 1980's, 46 percent of land converted to urban uses came from cropland and pasture, 38 percent from forestland, and 14 percent from range land.

Aside from the direct economic use of these lands in farming and timber production, they provide amenities that cannot be measured in the marketplace. Individuals may derive pleasure from the use of these lands for recreational purposes, they may enjoy viewing these lands from a distance, or they may derive pleasure from knowing that these lands are being protected from development. Rural land provides nearby residents an absence of congestion and scenic views for which they are willing to pay. In other words, rural land may be valued most for what it is not, namely, developed land. For example, focus groups conducted by the American Farmland Trust of residents in Kane, McHenry, and DeKalb Counties in Illinois found that the most important aspect of open space for these residents is its role in slowing growth and reducing development (Krieger, 1999). This result is borne out by contingent valuation studies used to estimate the amount people would be willing to pay to preserve land in agriculture. Halstead (1984) and Beasley, Workman, and Williams (1986) found that households were willing to pay about $150 each to preserve an acre of average-quality farmland when the replacement for agriculture was hypothesized to be high-density development, but only about $50 if the alternative was low-density development.

Nonmarket Values Associated With Preserving Open Space

Previously published estimates give benchmarks for estimating the total economic value of preserving open space. All of the six studies listed in table 4 directly asked individuals to state their willingness to pay for a change in farmland or asked them to vote yes or no to a set amount of money to preserve various amounts of farmland. For purposes of comparison, the average value of preserving 1,000 acres of farmland (converted to year 2000 constant dollars) appears in the last column of table 4.

The values reported in the six studies vary and are likely affected by study location. Beasely et al. (1986) and Halstead (1984) studied areas with scarce farmland, which is reflected by relatively high value estimates. Ready et al. (1997) focused on preserving horse farms, which tend to be a more specialized type of land than generalized agricultural land, and may thus have a higher value than other farmland. The Bergstrom et al. (1985), Bowker and Didychuk (1994), and Krieger (1999) studies were conducted in predominantly agricultural areas, which is reflected in their lower estimates of willingness to pay.

We used the Bergstrom et al. (1985) and Krieger (1999) studies to estimate benefits as an illustration of the potential nonmarket value for undeveloped farmland and open space in the United States, based on conservative estimates that reflect the preferences of U.S. residents. To estimate an aggregate value for land subject to development, we first estimated how many acres were threatened by development. Using the 1992 NRI and a variable measuring urban influence, acres by use class were identified in low, medium, and high urban influence categories. Of 3,077 U.S. counties, 1,062 have some land in at least one of these urban influence categories (figure 23). Comparing the areas of urban influence with areas that changed to developed land uses between 1982 and 1992 shows that the urban influence boundaries capture most of the area experiencing development (figure 24).

Table 4—Estimates of the average amenity value of farmland[1]

Study	Geographic area	Good valued	Annual value per 1,000 acres per household (2000 constant dollars)
Bergstrom et al., 1985	South Carolina	Prevent development of agricultural land	$0.21-$0.54
Beasley et al., 1986	Alaska	Prevent development of agricultural land	$17.56
Krieger, 1999	Illinois	Prevent development of agricultural land	$2.93
Halstead, 1984	Massachusetts	Prevent development of agricultural land	$17.82-$49.80
Ready et al., 1997	Kentucky	Prevent development of horse farm	$4.34-$4.94
Bowker and Didychuk, 1994	New Brunswick, Canada	Prevent development of agricultural land	$1.08-$2.45

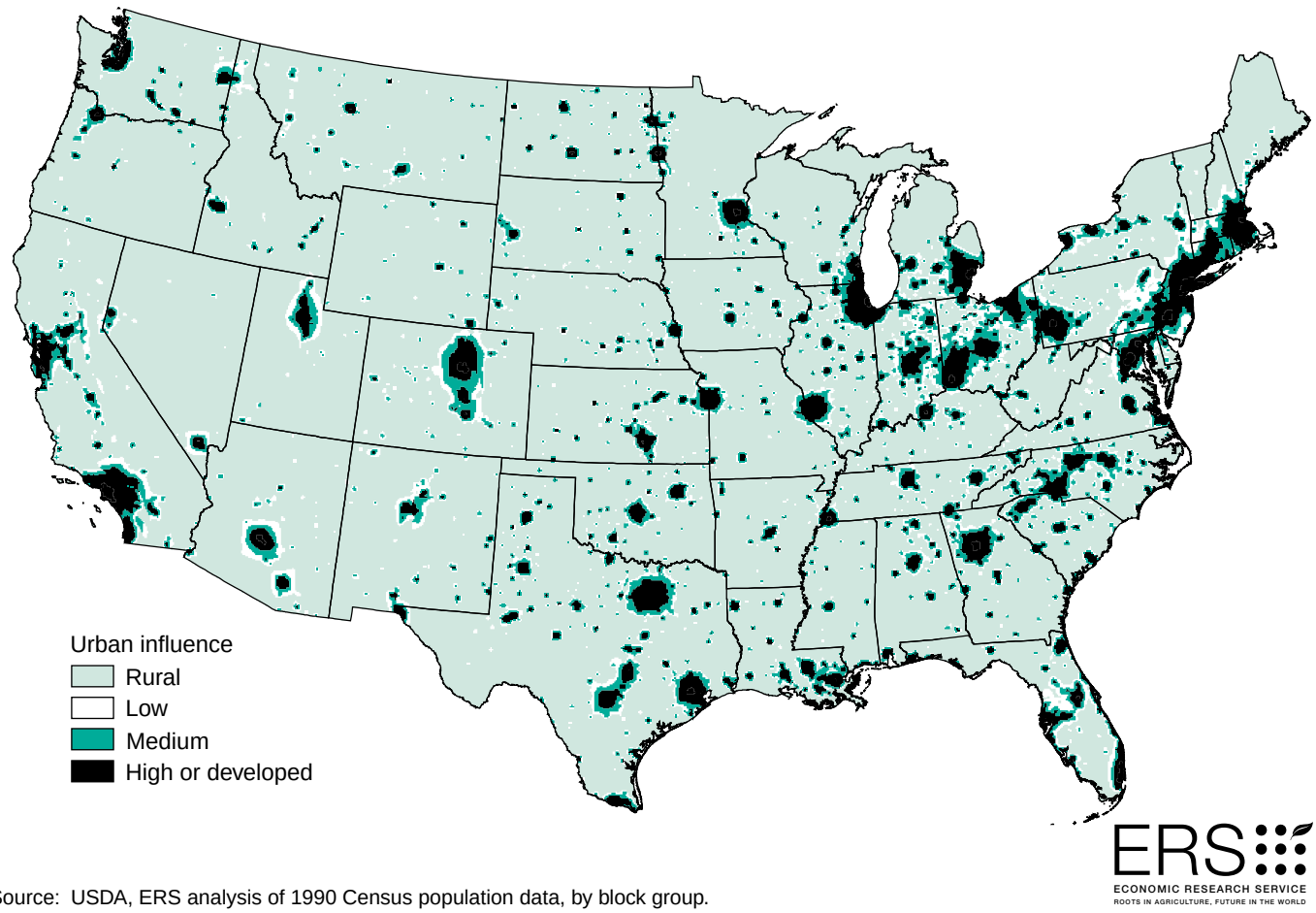
[1]All estimates are determined using the contingent valuation method with exception of the lower Ready et al. value, which used the hedonic property value approach. Values are average per household values inflated to year 2000 dollars using the April 2000 CPI.

We examined two potential development scenarios. In the "low-density" scenario, we assumed that 10 percent of the acres will be developed in the lowest urban influence class over the next few decades, 20 percent in the medium class, and 60 percent in the highest class, an estimate of the potential development in these areas is 50 million acres (table 5). In the "high-density" scenario, we assumed that development is more weighted to the high urban influence areas, with 90 percent of land there developed, 10 percent of the acres are developed in the medium urban influence area, and only 5 percent in the low urban influence area.

Most of the studies, including the two selected, asked respondents to place a value on preventing development near their residence. To generalize the results of the two selected studies to the Nation, we assumed that the public is willing to pay to preserve threatened open space only in their county of residence. We used the lowest of Bergstrom's willingness-to-pay estimates ($0.21 per 1,000 acres) because Bergstrom concentrated on farmland only. Accounting for all types of land, residents of counties expected to face development over the next few decades across the Nation were estimated to be willing to pay from $1.4 to $26.6 billion per year, depending on which willingness-to-pay estimate and development scenario was considered.

These estimates are subject to a great deal of qualification. Because the amount and location of open space varies so much from site to site, better estimates would have to focus on the actual and potential settlement patterns in particular areas to account for local supply and demand conditions, particularly the availability of alternatives to existing farmland. Most valuation studies of this type are valid for only marginal changes. Because we are estimating many years of development, the values now held by residents would likely change as development proceeds. The likely direction of these qualifications is not easy to determine. Thus, the estimates presented here serve more to illustrate the potentially large value the public may place on preserving

Figure 23
Degree of Urban Influence, 1990



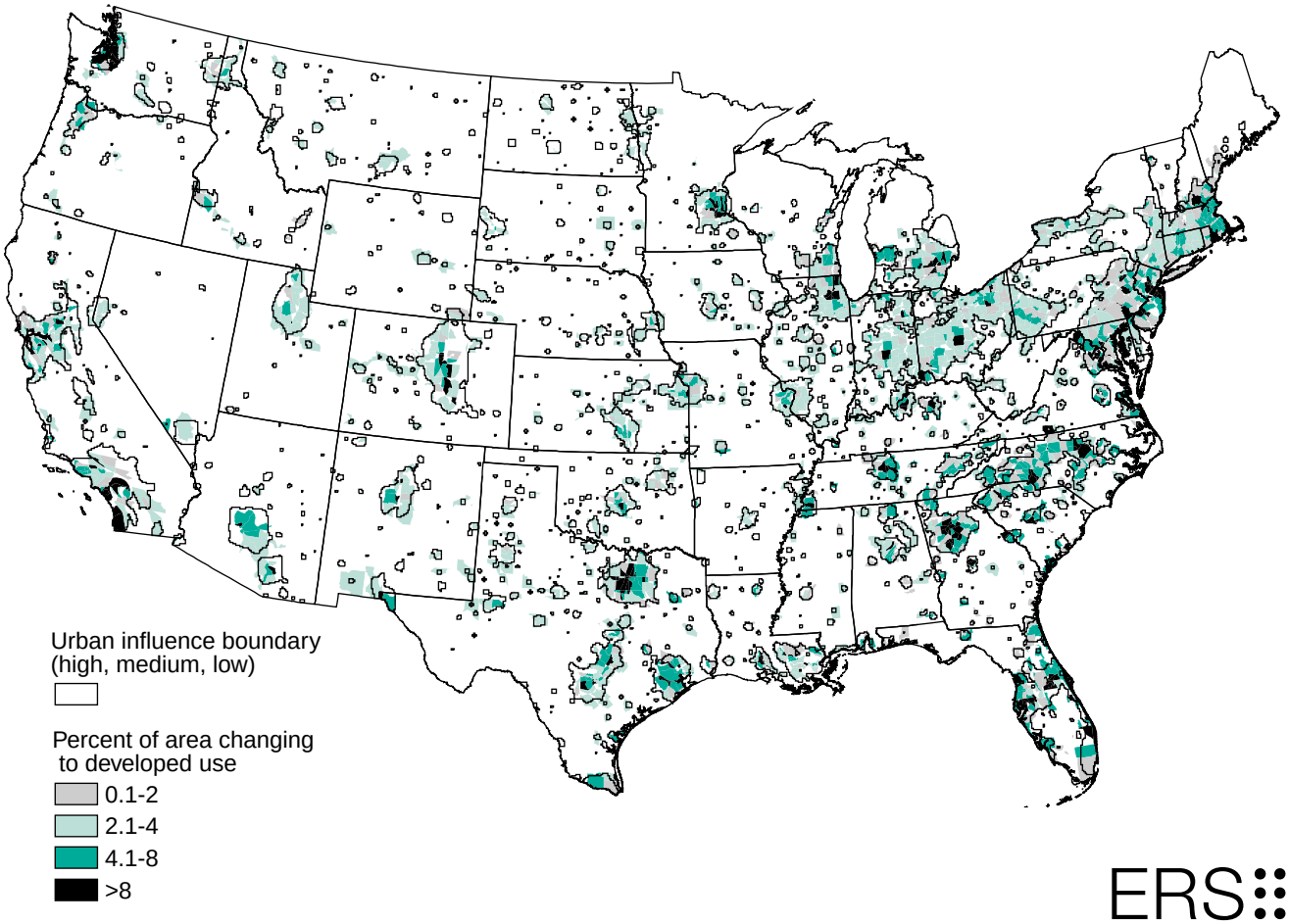
Source: USDA, ERS analysis of 1990 Census population data, by block group.

Estimating Erosion Damages from Growth

To estimate erosion damages, we used a model developed by Feather and Hellerstein (1997) that estimates changes in use values for water-based recreation associated with changes in ambient erosion, using the revealed preference method. To estimate the loss in use values, we estimated average changes in soil erosion that are caused by development at the NRI polygon level. The three urban influence categories from the analysis above (low, medium, and high) were identified, with the same 10 percent, 20 percent, and 60 percent conversion factors. Since each NRI polygon falls into only one urban influence category, a percentage of farmland in each polygon was randomly selected based on the proportion of total land expected to be developed. The Universal Soil Loss Equation (USLE) for each selected NRI sample point (representing a parcel of farmland being developed) was manipulated to predict erosion that would occur during development. NRI data do not contain USLE erosion information on types of lands other than farmland. For this reason, only farmland could be considered in this portion of the analysis. This is done by changing the USLE equation C and P factors to 1.0 (as suggested in USDA, 1978). Average erosion for the entire polygon is then re-computed. This is the average erosion that would occur in the polygon during development. Best management practices (BMPs), which are mandated by many States during construction, lessen erosion to some degree. The use of these practices is approximated by reducing the C factor to 0.7 from 1.0.

Figure 24

Comparison of estimated urban growth boundaries and percent of area changing to developed uses, 1982-92



Source: USDA, ERS analysis of Census of Population 1990 and 1992 National Resources Inventory data.

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Table 5—Estimated nonmarket value of land under urban influence estimated to be developed in succeeding decades

	Degree of urban influence[1]			
	Low	Medium	High	Total
Developable land		*Thousand acres*		
Cropland	30,179	30,690	33,840	94,709
Pasture/range land	28,424	25,077	21,299	74,800
Total developable land	58,603	55,767	55,139	169,509
Land assumed developed				
Low-density scenario[3]	5,860	11,153	33,083	50,096
High-density scenario[4]	2,930	5,577	49,625	58,132
	Estimated annual value of conserving rural land[2]			
		Billion dollars		
Low-density scenario[3]				
Proportion assumed developed	10%	20%	60%	
Low-benefit estimate	0.1	0.1	1.2	1.4
High-benefit estimate	.8	1.6	16.9	19.3
High-density scenario[4]				
Proportion assumed developed	5%	10%	90%	
Low-benefit estimate	>0.1	0.1	1.8	1.9
High-benefit estimate	0.4	.8	25.4	26.6

[1]See box "Methods for Estimating Cropland and Farmland Purchase of Development Rights Cost" (p. 62) for a description of how urban influence is determined.

[2]Total willingness to pay (in year 2000 dollars) for preserving all land indicated in the row weighting scheme based on $0.21 per 1,000 acres for the low-benefit estimate, $2.93 per 1,000 acres for the high-benefit estimate.

[3]Assuming development is distributed more broadly, 50.1 million acres are developed.

[4]Assuming development is more concentrated in the areas of highest urban influence, 58.1 million acres are developed.

Source: ERS analysis of 1992 National Resources Inventory and NASS June Ag Survey land value data.

open space under three hypothetical development schedules than any prediction of development or how residents value conservation.

The total benefit estimated also depends on the pattern and level of development expected to occur, which cannot be predicted with very much accuracy. In the "low-density" scenario in table 5, arbitrary percentages of the land in each urban influence zone are assumed to be developed, totaling 50 million acres, resulting in annual losses of nonmarket value of between $1.4 and $19.3 billion. However, if more development occurred and if it were more focused on the area of most heavy urban influence, as in the "high-density" scenario, 58.1 million acres would be developed with annual benefit losses ranging from $1.9 to $26.6 billion. This results partly because of the increase in development level, and partly because there are more households in the high urban influence zone than in the other two, resulting in higher values.

These willingness-to-pay estimates do not include off-site damages that result from construction, such as the reduction in surface water quality caused by erosion from construction sites. Clearing land for construction causes significant erosion, beyond that experienced in agricultural production. This increased runoff diminishes the quality of nearby lakes and streams that are used for recreation. Although these damages occur in a short period (1-2 years), they are potentially significant and were estimated (see box "Estimating Erosion Damages from Growth"). The estimated annual losses due to erosion are $0.93-$1.06 billion without construction best management practices (BMPs) and $0.67-$0.79 billion with construction BMPs, depending on settlement patterns (table 6).

Table 6—Annual recreational water quality damages due to urbanization of farmland[1]

Scenario (percent of high, medium, and low urban influence assumed developed)	Erosion damages	
	No BMP	With BMP
	Billion 2000 constant dollars	
Low density (60, 20,10)	0.93	0.67
High density (90, 10, 5)	1.06	0.79

[1]Annual losses due to changes in erosion resulting from conversion of farmland to urban uses. Losses are reductions in the enjoyment (use value) of water-based recreation resulting from diminished water quality. Estimates are inflated to year 2000 dollars using the April 2000 CPI.