# The Economic Value of Open Space: A Review and Synthesis

**Charles J. Fausold and Robert J. Lilieholm © 1996**

---



**Lincoln Institute of Land Policy Research Paper**
**Lincoln Institute Product Code: WP96CF1**

**Abstract**

This paper reviews several approaches for measuring and expressing the economic value of open space, and summarizes examples of each from published reports and research findings. Included are fiscal impact studies, market and enhancement value, natural system value, use and nonuse value, production value, the revenue generated by open space-related activities, and various intangible values. These values are not universally present within a given community, nor are they quantitatively additive. However, a comprehensive consideration of the multiple values of open space will better inform community decisions about land conservation and development.

**About the Authors**

Charles J. Fausold is a fellow at the Lincoln Institute of Land Policy, where he develops educational programs and conducts policy research in the areas of growth management and land conservation. He has held several elected and appointed positions in local government and served six terms as president of a regional land trust. Previously he was director of environmental programs for the New England Governors' Conference, Inc.

Address: Lincoln Institute of Land Policy, 113 Brattle Street, Cambridge, MA 02138-3400. Phone: (617)661-3016, X116 Fax: (617)661-7235 E-mail: cfausold@lincolninst.edu

Robert J. Lilieholm is associate professor in the Department of Forest Resources at Utah State University where he teaches forest management and economics as well as an honors course on private property rights and environmental protection. His current research interests include wilderness and adjacent land uses and the economic value of open space. He is the author of numerous articles and consults for both public and private sector clients. He was a visiting fellow at the Lincoln Institute of Land Policy during 1994-1995.

Address: Department of Forest Resources, Utah State University, Logan, UT 84322-5215. Phone: (801)797-2575 Fax: (801)797-4040 E-mail: rjl@cc.usu.edu

The authors are grateful to the Boston Foundation's Fund for the Preservation of Wildlife and Natural Areas, which provided major support for this project. Additional support was provided by the Lincoln Institute of Land Policy and Utah State University.

**Contents**

**The Economic Value of Open Space: Review and Synthesis**
**Introduction**

Governments have long recognized the need to preserve certain open space lands because they are important providers of public goods and services such as food, fiber, recreation, and natural hazard mitigation, or because they possess rare geological or biological features.[1] Several factors point to the continuation and expansion of open space preservation efforts.

First, it is expected that the predominant form of urban growth will continue to be unbounded low density development on the metropolitan fringe. One of the consequences of this form of growth is the loss of accessible open space and sensitive environmental areas (Downs 1994, U.S.Congress 1995). As the supply of open space within metropolitan regions decreases, its value and efforts to preserve that value will increase.

Second, global economic change and the telecommunications revolution now make it possible for growing numbers of relatively high-income households to live in rural and semi-rural areas, subjecting non-urban areas to urban-like influences. While the amount of land developed as a result of such changes may be small, the land use and socio-economic impacts on specific communities may be significant. For example, land used for forestry, farming or ranching may be fragmented into smaller parcels that make those former uses no longer economically viable.

Third, anecdotal evidence suggests that the owners of many of the most significant open space properties in the United States are over 55 years of age (Small 1996). Over the next 20 years, rising land values and estate tax pressures may result in the fragmentation or sale of these properties for development.

Finally, there is increasing interest in the concept of ecosystem management as an approach to better land use and the protection of endangered species, as well as the reconciliation of economic and ecological objectives (Wheeler 1996). Implementation of this approach will require preservation of large, contiguous blocks or networks of open space.

It is likely that decisions about open space preservation will increasingly be made at the local level. This is due in part to the general trend of devolution of governmental responsibility (with accompanying fiscal responsibility), as well as an increase in institutional capacity to carry out conservation projects at the local level. Nationwide, there are now over 1100 private land trusts which have preserving open space as their primary mission (Hocker 1996). Increasingly, land trusts are developing capacity and experience in land management and stewardship, supplementing the services provided by state and local governments.

Since local governments operate within an increasingly tight fiscal environment and are heavily dependent on the property tax for operating revenue, the fiscal and economic implications of open space preservation decisions are paramount. Conservationists will increasingly be called upon to demonstrate the economic value to the community of open space preservation.

While much has been written about the economic value of the environment in general and of open space in particular, the literature is segregated by discipline or methodology. It is therefore difficult to comprehensively assess the economic value of open space. It is even more difficult to

apply what is known in a public policy context.[2] This paper establishes an economic context for discussions and decisions concerning open space preservation by reviewing and synthesizing the literature on various ways of thinking about and measuring the economic value of open space. The authors recognize that some values of open space cannot be valued in monetary terms, and we address this topic as well.

### Concepts of Value, Public Goods, and Common Property Resources

Like natural ecosystems, open space provides a variety of functions that satisfy human needs. deGroot (1994) has suggested a system for valuing natural systems based on a checklist of 37 functions, grouped into four categories: regulation functions (ecological processes and life-support systems that supply and protect the quality of air, water and soil); carrier functions (providing space and substrate for habitat, recreation, cultivation); production functions (producing food, fiber, energy and genetic material); and information functions (providing opportunities for reflection, spiritual enrichment and cognitive development).

Attempting to assign values to open space functions presents several challenges. First, open space typically provides several functions simultaneously. For example, the same wetland that buffers the impact of peak storm flows may also provide important aquatic habitat for wildlife. Second, different types of value are measured by different methodologies and expressed in different units. Converting to a standard unit (such as dollars) involves subjective judgments and is not always possible. Third, values are often not additive, and "double counting" is an ever-present problem. Finally, some would argue that it is morally wrong to try to value something which is by definition invaluable. At a minimum, open space will always possess intangible values in addition to any monetary values that may be calculated.

### Public Goods and Common Property Resources

Open space often plays an important role in the provision of "public goods" and "common property resources." Public goods have two characteristics. First, they are nonexcludable, meaning that once they are produced, it is impossible or very costly to exclude anyone from use. Second, public goods are nonconsumptive, meaning that one person's enjoyment of the good does not diminish its availability for others.

[3]. Examples of public goods produced by open space include clean water, clean air, and biological diversity (Tietenberg 1996). Other public goods more directly associated with open space protection efforts include scenic vistas, the community character embodied in traditional working landscapes, solitude or simply the lack of human congestion and occupation, and viewing the many forms of wildlife that typically depend in part on habitat provided by open space.

Open space can also produce common property resources--resources that are owned in common, rather than privately, by some defined group of co-owners. [4] For example, privately-owned open space may serve a vital role in the production of common property resources such as fish and wildlife. In the case of wildlife, open space produces both public goods (e.g., bird and animal watching) and consumptive resources (e.g., hunting and fishing).

Since landowners typically cannot control access to public goods and common property resources, market allocation systems often fail to develop, and these goods and services are underproduced by the private sector.[5] [6] As a result, easily observed measures of value, like those expressed through market prices, do not exist. Yet land use and resource management decisions imply tradeoffs between marketed and non-marketed goods and services, making it difficult to compare relative values and, through tradeoffs, arrive at socially-optimal decisions.

### Examples of the Economic Value of Open Space

There are a number of approaches to measuring or conceptualizing the economic value of open space. In the following section, we address several such approaches and provide examples of each. We begin with fiscal impact analysis, since in its broadest sense it is the method by which measures of value are considered in the community decision-making process.

### Fiscal Impact Analysis

Since about 1970, there has been a growing awareness that local population growth and real estate development do not necessarily provide net fiscal benefits to local governments; that is, providing infrastructure and other services to accommodate new development may cost more than the development generates in property tax and other revenues (Altshuler et al. 1993). This is especially true in rapidly-growing communities (Ladd 1992, RKG Associates 1989, Altshuler et al. 1993). As a result of decreased intergovernmental transfers of financial aid, and increasing citizen resistance to taxes, local officials now scrutinize the fiscal consequences of land use decisions more than ever before.

The primary analytic tool available to policymakers for this purpose is fiscal impact analysis, where the direct, current, public costs and revenues associated with residential or nonresidential growth are projected to determine the net fiscal impact of development in the local jurisdiction(s) in which the growth is taking place (Burchell and Listokin 1978). By examining only direct and current impacts, fiscal impact analyses rarely if ever measure spillover effects (such as when growth is displaced to a neighboring town) or long-term effects (such as residential growth spawned by new commercial or industrial development).

Variously referred to as cost-revenue analysis or cost of community services analysis, fiscal impact analysis has been in use for 60 years. Burchell and Listokin (1992) trace the evolution of the technique from its use in analyzing the early public housing programs in the 1930s to recent applications justifying the preservation of open space.

Fiscal impact analysis is often utilized in larger communities on the metropolitan fringe which are experiencing growth pressures. However, the technique also offers the promise of assisting local governments in rural areas in developing appropriate responses to economic, social and demographic change (Kelsey 1993).

Numerous guides to the methods and application of fiscal impact analysis are available (Burchell et al. 1985, Freedgood and Wagner 1992, Tischler 1988, Burchell and Listokin 1980, Ad Hoc Advocates 1990, Burchell and Listokin 1978). Burchell and Listokin (1992) summarize the four basic steps:

- estimate the population generated by growth (i.e. number of new residents, school-age children, employees, etc.);
- translate this population into consequent public service costs;
- project the revenues generated by growth; and
- compare development-induced costs to revenues; if costs exceed revenues a deficit is incurred; if revenues exceed costs a surplus is realized.

In recent years fiscal impact analysis has been applied to open space preservation, comparing the net effects on municipal budgets of open space (including lands used for agriculture and forestry) to other forms of land use. Typically, such analyses are performed by or with support from organizations which advocate preservation of open space and forest and agricultural lands. Burchell and Listokin (1992) summarize the general conclusions of such studies as follows:

1. Residential development typically incurs a net fiscal deficit.
2. Nonresidential development generates a fiscal surplus, but attracts residential development.
3. Open space is fiscally better than residential development and equal to or better than nonresidential development.

Examples of findings include the following:

- The Northeastern Office of the American Farmland Trust, which has pioneered the cost of community services approach, studied six rural towns in Connecticut, Massachusetts and New York State and found that on average residential development required $1.13 in municipal services for every $1 of revenue generated. Farm, forest and open space land required only $0.29 in services per dollar of revenue (Freedgood and Wagner 1992).
- The Commonwealth Research Group (1995) studied eleven southern New England towns using the American Farmland Trust methodology and found that on average, for every dollar of revenue raised, the towns spent $1.14 in services for the residential sector, $0.43 for the commercial/industrial sector, and $0.42 for forest, farm and open space.
- Tischler & Associates (1989) studied the projected fiscal impacts of seven non-site-specific land uses in Groton, Connecticut. The study found that a prototype open space tract of 40 acres, devoted 60% to passive recreation and 40% to active recreation, would incur an annual municipal deficit of $211,951 per year. These findings, which contrast with the results of the American Farmland Trust studies, are explained by the fact that the publicly-owned parcel would generate no tax revenue and incur costs of land acquisition, debt service over 20 years, and development and maintenance. Presumably the deficit would diminish once the debt is retired.

Drawing on their own extensive experience and reviewing the literature on fiscal impact analysis generally and its application to open space in particular, Burchell and Listokin (1992, 1995) have developed a hierarchy of land uses and fiscal impacts ranging from research office parks at the top (net fiscal surplus) to mobile homes at the bottom (net fiscal deficit). In this hierarchy, open space and undeveloped or unimproved land falls in the middle, just above the break-even line for municipal budgets.

Fiscal impact analyses must be carefully evaluated, since the choices of methodology and assumptions greatly influence the findings. It has been noted, for example, that "the results of most fiscal impact analyses conform with the policy inclinations of the governments or organizations that sponsored them" (Altshuler et al. 1993, page 92). Burchell and Listokin (1992) also note that few fiscal impact analyses are tested for reliability by comparing actual costs and revenues after development with pre-development projections. Finally, since specific

circumstances vary considerably from community to community, generalizations should be made with caution.

Nevertheless, as its application spreads and methodologies improve, fiscal impact analysis is becoming an increasingly powerful and sophisticated planning tool for guiding land use decisions at the community level. Its greatest benefit may be in prompting a reassessment of the "conventional wisdom" about the economic consequences of development and conservation. Fiscal impact analysis will not by itself answer the question of whether a particular parcel of land should be preserved as open space or developed. However, it can help frame the discussion and lead to more informed decisions by policymakers, conservationists and the public.

### Market Value and Enhancement Value

The most direct measure of the economic value of open space is its real estate market value; that is, the cash price that an informed and willing buyer pays an informed and willing seller in an open and competitive market. In rural areas where the highest and best use of land is as open space, this is easily determined by examining market transactions. In urban or urbanizing regions, however, where highest and best use (as determined by the market) is typically development, the open space value of land must be separated from its development value. Such a separation is in fact required when land is placed under a conservation easement[7].
It is difficult to generalize about the market value of land preserved as open space under a conservation easement, since conservation easements are a relatively recent device and there are likely to be few if any comparable sales of properties burdened with an easement. Moreover, individual land parcels and the terms of the easements themselves are infinitely variable. For example, in Concord, Massachusetts, a suburban Boston community with a relatively high number of conservation easements (54 out of 6,000 properties), the effect of a conservation easement on market value ranged from a 5 to 100 percent reduction in value (Closser 1994).

As conservationists are increasingly successful in achieving their goal of preserving open space, interesting and important policy questions are arising over the valuation of such land. For example, Adams and Mundy (1991) suggest that as a significant market in high amenity natural land emerges (i.e., there are more comparable sales of land preserved for open space), it will be possible to apply the standard concept of highest and best use (i.e., the use which yields the highest return to the landowner) in appraising the value of the property. In fact, the open space value may well be higher than the highest and best economic use value.

Similarly, Vicary (1994) suggests that as conservation easements become more prevalent, the preferred method for appraising their value should shift from the traditional before and after method (i.e., value of easement equals the value of property before easement is applied minus the value after) to the direct comparison of sales of comparable easements. He notes that this change will result in valuing the easement from the perspective of a conservation organization or government agency (which comprise the market for conservation easements) rather than a developer. While such an approach would more accurately capture the values of open space discussed elsewhere in this paper, it may also make achieving open space preservation more expensive. For this very reason and others, Roddewig and Papke (1993) warn against use of the concept of public value in a real estate context.

The question of whether the market value of open space must be limited to its highest and best economic use or whether it can include can include some of the other types of value discussed in this paper has not been settled. The Appraisal Institute takes the position that:

- If the purpose of an appraisal assignment is to estimate market value, then the highest and best use of the property to be appraised must be an economic use.
- Preservation and conservation are not recognized as economic alternatives to be considered in the highest and best use analysis.
- Transactions involving purchasers whose intent is to preserve/conserve privately owned natural lands should not be considered as reliable evidence in support of the market value estimate (Hanson 1996).

However, this position has not been universally accepted by professional appraisers. (See, for example, Fay, et al. (1996)).

The existence of open space may affect the surrounding land market. In 1919 the landscape architect Frederick Law Olmstead, Jr. observed that "It has been fully established that a well-located school and play-ground, or even a site for the same, ... adds to the value of all the remaining land in the territory to be served by the school more than the value of the land withdrawn for the purpose, just as a local park ... adds more to the value of the remaining land in the residential area which it serves than the value of the land withdrawn to create it" (as cited in Weiss 1987, p. 60). For the purpose of this discussion, we refer to this value of open space as enhancement value.

Evidence of enhancement value is commonly found in real estate advertisements that feature proximity to open space amenities. It is also explicitly recognized by federal income tax law. U.S. Treasury regulation Sec. 14(h)(3)(i) requires that the valuation of a conservation easement take into account (i.e., be offset by) any resulting increase in the value of other property owned by the donor of the easement or a related person. Section 14(h)(4) cites as an example a landowner who owns 10 one-acre lots and donates an easement over eight of them: "By perpetually restricting development on this portion of the land, (the landowner) has ensured that the two remaining acres will always be bordered by parkland, thus increasing their fair market value..." (Small 1990).

Several empirical studies have sought to measure the enhancement value of various types of open space such as neighborhood and large urban parks, greenbelts, waterbodies and wetlands. Some examples are given below.

An early study of a 10-acre neighborhood park in Lubbock, Texas found that within a two-and-one-half block area around the park land values declined with distance from the park (Kitchen and Hendon 1967). The study did not find a significant correlation between distance from the park and property (house and land) sales prices, perhaps, as the authors suggest, because only the land values were sufficiently homogeneous for the correlations to be revealing.

Another study of five parks in Columbus, Ohio found a positive impact (7 to 23 percent) on property values where properties faced open space (Weicher and Zeibst 1973). The effects were insignificant or negative where the property backed onto a park, or where the view was of an

intensively-used recreation facility such as a ballfield or playground. Properties facing a park sold for $1,130 more than similar properties one block away; properties backing onto a park sold for about the same; and those facing intensively-used recreational facilities sold for about $1,150 less during the period 1965-69.

A 1974 study of land values surrounding 1,294-acre Pennypack Park in northeast Philadelphia found a statistically significant rise in land value with proximity to the park, when controlling for other factors (Hammer et al. 1974). The park accounted for 33 percent of the land value at 40 feet, 9 percent at 1,000 feet, and 4 percent at 2,500 feet. The authors concluded that each acre of parkland generated a value of $2,600 in location rent (or, as used in this paper, enhancement value).

Correll et al. (1978) found that in Boulder, Colorado, the existence of greenbelts (linear open space features such as trails or stream corridors) had a significant impact on adjacent residential property values. While controlling for other variables, they found properties adjacent to greenbelts in the three neighborhoods studied to be worth an average of 32% more than those 3,200 walking feet away. The relationship was linear: a $4.20 decrease in the price of residential property for each foot away from the greenbelt. In one of the neighborhoods the aggregate property value was approximately $5.4 million greater than it would have been without the greenbelt, resulting in a potential additional annual neighborhood property tax revenue of $500,000.

An interesting policy finding of the Boulder study is that the effect of open space on neighborhood property values depended critically on how well the open space was integrated into the neighborhood. Open space had a greater positive effect on property values in the neighborhood where it was purchased prior to construction and included in the neighborhood design than it did where it was purchased after construction and separated from the neighborhood by a major limited access highway.

Nelson (1985) examined how greenbelts influence regional land values including urban, greenbelt, and exurban areas. He found empirical evidence in the literature that greenbelts increase the value of urban land in proximity, and theorized that this effect also extends to the exurban land market where people will locate and commute through the greenbelt to employment locations in the urban area. Within the greenbelt itself, land values are reduced where the greenbelt is created by large-lot zoning as opposed to the purchase of development rights or conservancy zoning, and also reduced along the urban fringe as restrictions on agricultural practices reduce farm value.

Parsons (1992) found that land use restrictions in Maryland designed to protect Chesapeake Bay caused a considerable increase in housing prices, ranging from 14 to 27 percent for houses within the Critical Zone (1000 feet inland from the Bay and major tributaries) to between 4 and 11 percent for houses up to 3 miles away. Unfortunately, his analysis was not able to distinguish between price increases due to limitations on the supply of land available for development and increases due to the enhancement value of open space capitalized into the value of the land (and subsequently housing prices).

Thibodeau and Ostro (1981) utilized two methods to estimate the enhancement value of 8,535 acres of wetlands in Massachusetts's Charles River basin. A multivariate regression analysis found that properties abutting the wetlands were worth $400 more than non-abutting properties, and that each acre of wetland added $150 in value to adjacent properties. A survey of 15 appraisers and realtors yielded the estimate that each acre of wetlands contributes $480 to the value of an abutting parcel of property.

Lacy (1990) analyzed property value appreciation rates (as measured by resales over time) for open space or "cluster" subdivisions[8] in Concord and Amherst, Massachusetts. In Concord, properties in an open space subdivision appreciated 167.9% between 1980 and 1988, compared to 146.8% for the town as a whole. In Amherst, houses in an open space subdivision appreciated 462% between 1968 and 1989 while houses of similar size and price in a conventional subdivision appreciated 410% during the same period. Market value and enhancement value of open space correlate strongly with development risk and land scarcity. In rural areas where most land is open space and likely to remain so (or at least is perceived to be at low risk for development) both market and enhancement value will be low. However, in urban or urbanizing areas where open space is scarce or diminishing (or in rural areas with unique amenities such as scenic views) market and enhancement value will be high. For advocates of open space protection, enhancement value is important because it offsets the negative effects of removing the market value of the open space itself (which is usually tax-exempt or taxed at a low rate) from the local property tax base.

### The Value of Open Space as a Natural System

Open space often supports natural systems that provide direct benefits to human society such as ground water recharge, climate moderation, flood control and storm damage prevention, and air and water pollution abatement. One way to estimate the monetary value of such benefits is by calculating the cost of the damages that would result if the benefits were not provided, or if public expenditures were required to construct infrastructure to replace the functions of the natural systems. Several examples illustrate this concept:

In Massachusetts, the U.S. Army Corps of Engineers, the Commonwealth of Massachusetts and local governments acquired 8,500 acres of wetlands in the Charles River basin to serve as a natural valley storage area for floodwaters. The cost of acquiring the wetlands was $10 million, while the cost of the alternative approach - -constructing dams and levees - - would have been $100 million (as cited in Kusler and Larson 1993).

A comprehensive analysis of this same wetland system (i.e., the Charles River basin) by Thibodeau and Ostro (1981) found that each acre of wetland had a present value conservatively estimated at $33,370 for flood prevention ($2,000 per year), $16,960 for pollution reduction (reducing nutrients and biological oxygen demand), and $100,730 for water supply (present value discounted at 6%, 1978 dollars).

The Minnesota Department of Natural Resources has estimated that the cost of replacing the natural floodwater storage function of wetlands is $300 per acre-foot of water (Floodplain Management Association 1994, as cited in Rivers and Trails Conservation Assistance 1995).

The total value of Dutch Wadden Sea coastal wetlands for flood prevention, storage and recycling of human waste, aquatic nursery, aquaculture and recreation, food production, education and scientific uses is estimated to exceed $6,200 per hectare per year (de Groot 1994).

The storm protection value of coastal wetlands in Louisiana was estimated to be $1,915 per acre (present value discounted at 8%, 1983 dollars) (Costanza et al. 1989).

One-third of the typical U.S. city is covered by tree crowns, and the American Forestry Association has calculated the following annual values provided by an average 50-year old urban tree (1985 dollars): air conditioning, $73; soil erosion and stormwater control, $75; wildlife shelter, $75; and air pollution control, $50 (as reported in Ebenreck 1988).

One concern environmentalists have with traditional attempts to calculate the value of open space is the use of a discount rate to arrive at the net present value of future benefits over a specified timeframe. Present value calculations are well-suited to capital equipment with a measurable life of 50 years or less. However, when applied to the benefits provided by natural systems (which continue indefinitely), positive discount rates effectively "discount" the interests of future generations. To the extent that the use of a discount rate cannot be avoided, however, a low rate should be utilized. de Groot (1994) has suggested a range of 1% to 6%, depending on how long it takes for the ecosystem in question to reach its climax stage. He notes that a preferred approach would be to consider annual value as interest on the capital stock of natural systems. With such an approach there are no time limits to the benefits derived and therefore the present value of the capital is infinite.

Farber and Costanza (1987) have developed an alternative approach to measuring the value of natural systems which calculates the gross primary production (biomass) of the system and converts it to a fossil fuel equivalent. Using this method, they found that the present value of coastal wetlands in Louisiana ranged from $6,400 to $10,000 per acre depending on the type of habitat. By comparison, a willingness to pay method (see below) for the same wetlands resulted in a total discounted value $590 per acre for commercial fishing and trapping, recreation and storm protection functions. The market value of the wetlands was $200 per acre. The authors noted that the willingness to pay figure is probably low because it did not include all functions, while the energy analysis value is high because it includes wetland products that are not economically valued.

### Use and Nonuse Values of Open Space

Just as the types of goods and services provided by open space vary, so do the types of use enjoyed by society. Much of the economic value associated with open space-related activities such as recreation can be broken into two broad categories: "use value" and "nonuse value." Use value results from some current use of the resource. Three types of use value are recognized (Bishop 1987):

1. "consumptive uses" such as hunting, fishing, and trapping;
2. "non-consumptive uses" such as hiking, camping, boating, enjoying scenery, viewing and photographing wildlife, etc.; and

3. "indirect uses" such as reading books or watching programs on open space-related resources or activities such as wildlife and travel.

In contrast to use value, nonuse values consider an individual's possibility for future use, or their altruism. Two broad types of nonuse value are recognized: "option value" and "existence value" (Weisbrod 1964, Krutilla 1967). Option value represents an individual's willingness to pay to maintain the option of utilizing a resource at some time in the future. Existence value represents an individual's willingness to pay to ensure that some resource exists. Part of the motivation for existence value may be the desire to bequeath the resource to future generations (Bishop 1987).[9] Many economists agree that under certain situations (e.g., unique or significant resources without close substitutes, or a resource facing irreversible harm), nonuse values across society can be very large and, as a result, should be considered in decision-making.[10] In addition, it is important to note that a single individual may possess all of these values with respect to a single resource.Recently, nonconsumptive use and nonuse values have received much recognition in the economics literature, largely fueled by growing nonconsumptive and nonuse activities by the general public. For example, Duda and Young (1994) estimated a 63% increase in participation in nonconsumptive, nonresidential wildlife viewing and diversity programs between 1980 and 1990. The President's Commission on Americans Outdoors (1987) found natural beauty was the single most important factor in deciding tourist destination. In addition, New England's governors have recognized open space as an important factor in the region's quality of life and tourism industry (New England Governors' Conference, Inc. 1988).

Considerable debate surrounds the precise definition of use and nonuse values with respect to a resource and, more importantly, their actual measurement (Freeman 1993). The valuation problem arises from the lack of markets and market prices, and the existence of administratively-set quasi-market prices such as hunting and fishing license fees.[11]Economists use the concepts of "consumer surplus" and "willingness to pay" to arrive at socially-meaningful estimates of value for many nonmarket resources. Consumer surplus is the maximum dollar amount above the actual market price that a buyer would be willing to pay to enjoy a good or service.[12] The concept was first developed by Dupuit (1844), and has stimulated considerable debate ever since. Most economists agree, however, that consumer surplus, in measuring value above and beyond that which is measured in the market, is relevant to many social decisions (Samuelson 1973). When consumer surplus across all users is combined with the actual market price, the total willingness to pay can be estimated.

To estimate consumer surplus, one must first derive the demand curve for the resource or service. Economists typically use one of two methods to do this--either the contingent valuation or the travel cost method (CVM and TCM, respectively). In CVM, a hypothetical market is created through use of a survey or questionnaire, and respondents are asked what they would be willing to pay (or the amount they would need to be compensated) to use (or lose) some defined resource or activity. In TCM, the cost of travel to a site is viewed as an entry or admission price, and a demand curve is derived from observing visitation from various origins with different travel costs.

Numerous studies have reported economic values for nonmarketed goods and services using CVM and TCM. Such use has provided numerous and sometimes conflicting estimates of value, and has generated heated debate in the economics literature (see, for example, Anonymous 1992,

Stirling 1993). Some comprehensive reviews of the literature assess the state-of-the-art and evaluate consistency in method and results. For example, Sorg and Loomis (1984) reviewed TCM and CVM willingness to pay estimates published since the mid-1960s for a wide range of recreational activities (e.g., fishing, hunting, camping, skiing, boating, etc.). Once the various willingness to pay estimates were standardized to consider inflation and site and methodological differences, they were found to be fairly consistent, and many of the remaining differences could be explained by variations in resource quality and relative location from user populations. More recently, Smith (1993) assessed the state-of-the-art and offered encouragement for continued development of nonmarket valuation techniques.

In fact, despite considerable debate, estimates based on CVM and TCM are increasingly accepted. For example, the National Oceanic and Atmospheric Administration (NOAA) commissioned a blue-ribbon panel of experts to evaluate the use of CVM in determining nonuse values for the assessment of damages resulting from oil spills under the Oil Pollution Act of 1990 (33 USC 2701). The panel's comprehensive report, published in the Federal Register Notice on January 15, 1993 (58 CFR 4601), while recognizing that many CVM studies over-estimate willingness to pay, also found the method suitable for estimating the value of nonmarket resource damage caused by oil spills and other toxic substances and recommended standardized procedures and future areas of research.

Many studies have sought to estimate the willingness to pay associated with various recreational activities. Typically these studies have examined hunting and fishing, but the range of topics being considered is expanding. Some examples are given below.

- Using CVM, Sorg et al. (1985) estimated that the gross value of a cold water fishing trip in Idaho was $80. This included $37 per trip in expenditures (e.g., transportation, food, lodging, tackle), plus $43 per trip in consumer surplus (i.e., the amount the typical angler would be willing to pay over and above actual expenditures).
- The net willingness to pay in addition to actual expenditures for elk hunting in Idaho ranged from $52 to $100 per trip in 1982 and 1983 (Sorg and Nelson, 1986).
- Swanson et al. (1989) examined big game hunting in Southeast Alaska. They estimated that total expenditures, net willingness to pay, and total hunting value for deer hunters was $4.4 million, $2.8 million, and 7.3 million, respectively, in 1984-1985. Nonresident mountain goat hunters had the highest total hunting value at $2,660 per hunter.
- Walsh and Gilliam (1982) estimated willingness to pay for recreationists in the Indian Peaks Wilderness Area of Colorado. Under noncongested conditions (i.e., 10 persons encountered per day) willingness to pay for hikers and backpackers was $15.68 per day and $20.81 per day, respectively. Under congested conditions (i.e., 50 persons encountered per day) these values dropped to $8.72 and $11.27, respectively. The study showed that under conditions of excess demand, newly-created wilderness areas would enhance values at existing sites by relieving congestion.
- Finally, the USDA Forest Service's Resources Planning Act (RPA) program lists estimated willingness to pay values for many outdoor recreation activities by Forest Service region.

Other studies have examined nonuse values. Some examples include:

- Stevens (1990), using CVM, estimated that average willingness to pay for maintaining populations of bald eagles, wild turkeys, and Atlantic salmon were $19, $12, and $8, respectively, for survey respondents. Respondents were roughly split between willingness to pay $5 to either protect or control coyotes.

- Walsh et al. (1984) estimated Colorado residents' consumer surplus under four scenarios of wilderness designation in the state: 1.2 million acres; 2.6 million acres; 5 million acres; and 10 million acres. The researchers divided total consumer surplus between the traditionally-used recreation use and preservation value (this second category included option, existence, and bequest value). Under the largest wilderness designation scenario of 10 million acres, the total annual recreation use value across all households was estimated to be $58.2 million. The preservation value to Colorado residents was estimated to be an additional $35.0 million--for a total wilderness value of $93.2 million. Preservation value was evenly broken-down between its three component values: option value ($10.2 million), existence value ($12.3 million), and bequest value ($12.5 million).

### Production Value of Open Space

Lands valued for open space are seldom idle, but rather are part of a working landscape vital to the production of goods and services valued and exchanged in markets. Often, the economic value resulting from these lands is direct and readily measured, as with produce from agricultural lands and wood products supplied by forests. The returns from production accrue directly to the landowner, and are important in that these returns, in relation to alternative land uses like development, often determine current and future land use. Some examples are given below.

Over 300 million acres of agricultural lands are harvested each year in the U.S., producing a combined value of over $86 billion. Although there has been a steady decline in the number of farms and acres under cultivation, the food and fiber sector of the economy directly or indirectly employs nearly 20% of all U.S. workers and produces 16% of the economy's total value-added (American Almanac 1993). In addition, agricultural exports generate a significant trade surplus, and accounted for 10% of the value of all U.S. exports in 1991 (American Almanac 1993).

Nearly 3.5 million acres of fruit and nut orchards provide open space in the U.S. (American Almanac 1993). About half of this area is planted to major deciduous fruits like apples, cherries, and plums, with citrus and nut orchards comprising much of the balance. Specialty crops like cranberries, kiwis, and berries are grown on 167,000 acres, and provided locally-important open space. In fact, cranberry bogs in New England and the Lake States provide both direct and indirect open space since for every acre of bog under cultivation, several acres of undisturbed wildland are needed to provide clean water.

Nearly one-third of the U.S., or 730 million acres, is forested (Davis and Johnson 1987). Two-thirds of this area is commercial, being capable of producing wood for commercial use. The wood products industry includes logging operations, sawmills, pulp and paper mills, and fuelwood producers. Secondary manufacturers produce furniture and fixtures, millwork, flooring, pallets, and panels. In 1992, these timber-based industries employed 1.7 million workers and processed an estimated 40 billion board feet of lumber (American Almanac 1993). Nearly 60% of commercial forestland is privately-held by farmers and other miscellaneous small owners, mostly located in the eastern U.S. (only 14% is controlled by forest industries, and 18% is located within national forests). While the total number of acres of forestland has increased 10% since 1952, the area available for harvest has actually declined 5%. Private lands near population centers face the greatest pressure for conversion to other uses. In addition to traditional extractive forest uses, a growing number of non-extractive "special forest products" are being harvested from forests. These products fall into five general categories: food, herbs,

medicinal products, decoratives (including floral greenery and dyes), and specialty items such as aromatic oils (USDA Forest Service 1990a).

Pasture and grazing lands cover substantial areas of the U.S., and supply meat, diary products, and fiber.

The production of some market-valued goods indirectly depends upon privately-owned open space. In such cases, the economic returns to production may accrue to others besides the landowner. An important example is the role of privately-owned wetlands in fish and shellfish production. Wagenaar Hummelinck (1984) estimates that roughly two-thirds of the world's fish harvest is hatched in tidal areas.

In addition to providing market-valued goods and services, direct and indirect production from open space lands supports jobs and related income that are valuable to local, regional and national economies. For example, farm expenditures on vehicles, equipment, and services totaled $23 billion in 1991 (American Almanac 1993). Nearly 3 million people were employed on farms in 1992, not including indirect employment from expenditures and services. Finally, state and federal payments to farms totaled $8.2 billion in 1991 (American Almanac 1993).

The aggregate production value of open space wildlands within particular states and regions can be significant, and the New England states have been at the forefront of recognizing the important economic contribution open space lands make to their economies. Some examples are given below.

The Northeastern Forest Alliance, created by the natural resources commissioners of Maine, New Hampshire, New York, and Vermont, conservatively estimated that the four-state region's forests contributed nearly $26 billion to the regional economy in 1987 (Northeastern Forest Alliance 1993). Other findings include:

- activities related to the northern forest employed 226,630 people, with a combined payroll of $3.3 billion;
- landowners received nearly $300 million in timber harvest revenues in 1989;
- wood-based manufacturers shipped more than $14.6 billion in products in 1987; and
- in 1987, the production of Christmas trees, maple syrup, and horticultural products generated nearly $75 million in Maine, New Hampshire, New York, and Vermont (Northeastern Forest Alliance 1990).

In Maine, natural resource-based industries supported 40% of goods-producing jobs, or 20% of all Maine employees (Benson 1994). Total combined sales from farm products and fish were $700 million, with a processed export value of $1.1 billion. Maine's forest products industry generated $4.3 billion, and tourism was estimated to contribute $1.5 billion to the state's economy in 1992. In 1992, Maine's forests supported 43.5% of the state's production and 29% of employment (Irland 1994).

### Revenues Generated by Open Space-Related Activities

Activities directly or indirectly associated with open space may generate significant expenditures and provide an important source of revenue for businesses and state and local governments. For example, revenues from hunting and fishing license sales are a major source of funding for state wildlife agencies. The fish and wildlife populations these activities depend upon often rely at least in-part on habitat provided by open space. Less direct but perhaps more important from an overall economic perspective are expenditures from open space-related activities such as hiking, hunting, fishing, bird watching, nature photography, snowmobiling, skiing, and mountain biking. Such expenditures include the purchase of equipment, travel costs, lodging and accommodations, guide services, meals, groceries, etc., as well as attendant jobs to provide such services. These expenditures also have income and job multiplier effects, and often occur in rural areas with limited commercial potential.

Many studies have quantified the economic impacts of these open space-related activities, yet few studies are found in the peer-reviewed literature. Typically, these studies are conducted by regional, state, or local tourism offices, industry trade groups, and increasingly, environmental organizations seeking to increase the recognition of the economic contribution of wildlands. Unfortunately, many of the groups conducting these studies have a potential conflict of interest since, for example, tourism offices want to promote the importance of tourism, and environmental groups seek to demonstrate the important economic contributions of environmental amenities. Nevertheless, while some of these studies should be interpreted with caution, they do indicate that open space-related expenditures can make significant contributions to economic activity at all levels--local, state, national, and international. Some examples are given below.

Tourism makes up 7% of global trade in goods and services, and $195 billion per year in domestic and international receipts (Harms 1994). There were a total of 370 million international tourists in 1987, up 20 million from the previous year. These tourists supported an estimated 74 million jobs. Adventure tourism, including ecotourism, comprised 10% of the market in 1989, and was increasing at 30% per year.

The National Fish and Wildlife Foundation (1994) estimates that in 1991, more than 24 million Americans took trips to watch wild birds. For comparison, 14 million Americans hunted, and 35 million Americans fished. Expenditures on non-game wildlife appreciation totaled more than $19 billion in 1991.

In 1991, almost 110 million Americans participated in wildlife-related activities and spent an estimated $59 billion. Anglers spent $24 billion, hunters spent $12 billion, and non-consumptive participants spent $18 billion (United States Department of the Interior 1993).

A USDA Forest Service (1995) report estimated that 13 million Americans canoe, 58 million fish, and 54 million camp. The fastest growing activities are hiking, backpacking, and primitive site camping.

In the U.S., tens of millions of birders spend over $20 billion each year on seed, travel, and birding equipment. Active birders spend between $1,500 and $3,400 on birding each year, most of which is spent on travel (Kerlinger 1993).

Boyle et al. (1989) estimated that in 1988, resident and nonresident moose hunters in Maine spent an average of $428 and $871 per hunter, for an aggregate impact of $470,000.

Kerlinger (1995) estimated that the direct expenditures by birders visiting eight selected National Wildlife Refuges in the U.S. ranged from $0.5 million to $14.4 million per refuge per year. In another study, 53,000 birders visiting Pennsylvania's Hawk Mountain Sanctuary were estimated to contribute $2.4 million to the local economy each year (Kerlinger and Brett 1995).

McElvany (1995) estimated that snowmobilers in Vermont during the 1993-1994 season generated $165 million in revenues, including multiplier effects.

The Northeastern Forest Alliance conservatively estimated that the four-state region's forests generated over $7 billion in 1987 from forest-based tourism and recreation (Northeastern Forest Alliance 1993). State revenue from these activities totaled an estimated $204 million (includes state taxes on meals and lodging--property taxes not included).

### Intangible Values of Open Space

Earlier sections focused only on open space values of interest to humans, and of those, only values that can be expressed in economic terms. However, it is important to note some of the intangible values of open space. Below are several suggested by Rolston (1988):

- scientific value -- understanding nature, and how it came to be;
- aesthetic value -- appreciating the beauty of a natural feature independent of its utility;
- genetic diversity value -- maintaining the capacity to adapt to environmental changes;
- historical value -- understanding ourselves by understanding our natural heritage;
- cultural-symbolization value -- the contribution of geomorphic, faunal or floral features to our sense of identity;
- character-building value -- the opportunity to test and learn one's limits and abilities;
- stability and spontaneity values -- nature is both constant and infinitely variable;
- dialectical value -- the value that derives from overcoming oppositional forces; and
- spiritual value -- the deep introspection inspired by wildlands as sanctuaries.

Another way to think about the value of open space is to consider whether open space, or nature, has rights. In a review of the history of environmental ethics, Nash (1989) traces the extension of the concept of rights to include an ever-expanding group of recipients, from various classes of human beings to animals, plants, ecosystems, the environment, the planet, and beyond. Each extension of rights, including those now widely accepted, was thought to be a radical idea at the time it was first proposed.

Legal scholars have also begun to address the topic. In a widely-debated article first published in 1972, Stone (1974) introduced the idea that natural objects such as forests, oceans and rivers should have legal standing in courts of law. More recently, Rose (1994) has suggested that a proper measure of restraint on our use of common property environmental resources could be

achieved by thinking of such resources as a "gift" to be passed on to others rather than just as a "given" to be used and controlled.

As Nash (1989) points out, appreciation for the intrinsic value of nature has been aided by advances in the science of ecology. An emerging (at least in Western culture) biocentric view, expressed best by Leopold's (1949) "land ethic," holds that human beings are part of their environment, rather than separate from it. Furthermore, the entire biotic community (or the land, as Leopold referred to it), is more important than any individual component, including humans.

In summary, the individual's appreciation of the intangible value of open space depends on where one's views lie along the continuum of thought that stretches from nature is to be exploited, to nature is to be used wisely, to nature has value independent of any utility to humans. Summed across society at large, the intangible value of open space will likely increase with continued advances in ethical thought and ecological knowledge.

## Discussion

Increasingly, communities across the United States are faced with conscious choices to be made about open space. Inhabitants of rural areas are realizing that even though they are geographically distant from urban areas they still may face significant land development pressures, and that existing open space areas will not necessarily remain without active intervention. At the same time, suburban communities on the metropolitan fringe are realizing that the loss of open space need not be a necessary consequence of growth. A growing array of new policy instruments and institutions such as conservation easements, private land trusts and cluster subdivision regulations enable growing communities to exercise much greater control over what gets developed and what gets preserved as open space. Even center cities and inner suburbs will find new opportunities for public open space in concert with the redevelopment of former industrial "brownfields" and other vacant land.

In each case, a deeper understanding of the value of open space will help to dispel "conventional wisdom" about the economic consequences of land development and conservation and better inform the choices that need to be made. What land should be preserved for open space and why, and what level of public resources should be applied to the preservation effort? If we cannot protect all the significant areas, then what are the priorities?

To answer these questions, each community will have to review the types of open space values described in this paper, decide which are most relevant to the local situation, and then attempt to describe or quantify those values more completely. Clearly, the important values will be community-specific.

As communities undertake this exercise, several important points should be considered. First, it will never be possible to completely calculate the economic value of open space, nor should it be. Certain intangible values lose significance when attempts are made to quantify them. In the long run, these intangible values may be the most significant.

Second, methods for determining and comparing value vary widely in level of sophistication and reliability. Some are based on long-established professional standards, while others continue to

evolve. Given the inherent subjectivity of the term, any discussion of value must encompass a variety of disciplines, methodologies and approaches.

Third, methods of determining or expressing open space values have the potential of misuse if they are too narrowly construed. For example, it would be inappropriate to conclude from a fiscal impact analysis that open space should be used to block residential development because the open space alternative is fiscally preferred. Clearly, an area which is comprised entirely of open space is no more a successful community than one which is composed entirely of industrial, commercial and high-end residential land uses (which tend to be even more fiscally beneficial than open space). Open space should be preserved for its own intrinsic values, rather than for the purpose of precluding other land uses, particularly if the net effect is to displace development to other, even more inappropriate sites or communities.

Valuation methods are appropriate, however, to justify the preservation of significant open space values as development proceeds in a given area. In fact, as noted elsewhere in this paper, open space which is thoughtfully integrated into a community's land use mix creates an enhancement value which further complicates the fiscal impact equation.

Fourth, valuation exercises may have unintended consequences. For example, if a convincing case is made that the value of a particular open space parcel as a public good exceeds its value for alternative economic purposes, then the costs of preserving that parcel through acquisition may be raised, unless the owner is particularly conservation-minded or public-spirited (and many are). If that acquisition is then used as a benchmark ("comparable sale" in appraisal terms) for determining the fair market value of subsequent open space acquisitions, the effect will be multiplied, increasing the overall cost of conservation. This raises interesting questions of creating and capturing value that are beyond the scope of this paper. Similarly, emphasizing the value of open space-related activities such as tourism may have negative impacts on the destination community as perceived by the residents (Allen et al. 1988, Pizam 1978).

Fifth, open space typically possesses many values simultaneously, some of which may be negative. Intensively-utilized and poorly-managed urban parks, agricultural practices such as pesticide spraying, and mosquito-breeding wetlands are examples of situations where open space may detract from the value of adjaent properties. Valuation exercises should account for both positive and negative values, as well as the net overall effect.

Sixth, the value of open space depends in part on its protection status. On the one hand, permanently-preserved open space is a non-depreciating asset with increasing benefits over time (Krutilla and Fisher 1975). On the other hand, open space which is not permanently protected has value in preserving land use options for future growth and development, while development is typically irreversible and can depreciate in value over time.

Finally, open space values are dynamic and must be considered comprehensively. For example, as open space is converted to developed uses within a region, production value (e.g., agriculture, forestry) may diminish while land development values rise, leading to increased pressure for additional development. At the same time, however, the wildlife and recreation value of these remaining open space parcels will likely increase. The problem with such situations is that while

the public value of the open space increases, its value to the private landowner decreases relative to alternative uses. This dilemma is at the heart of the property rights debate, and drives the development of innovative mechanisms such as habitat conservation plans which seek to reconcile public and private objectives.

## Conclusion

Viewing open space lands through an economic lens can provide important new insights. For example, open space can be seen as a non-depreciating, non-reproducible asset with increasing benefits through time. By contrast, poorly planned development can depreciate in value and create significant liabilities for communities. Similarly, open space possesses the option value of conversion to developed use, while development is rarely reversible.

Open space lands provide many types of value to landowners, private individuals, and society at large. While many valuation tools and techniques are available and some values are relatively easy to measure, others are not. Analyses of open space values must be comprehensive and avoid double-counting. Determining and expressing the many values of open space is important for raising public awareness of these lands, promoting the conservation of those that are especially significant, and allocating scarce resources.

Strategies and economic arguments in support of a particular open space conservation project must be community specific: an approach applicable to one community will not necessarily work in another. The arguments presented should consider all relevant quantifiable values, as well as those not readily quantified. It is hoped that the synthesis of different concepts presented in this paper will broaden understanding of the many values associated with open space, informing planners, conservationists, local officials and citizens as they make important decisions regarding these lands.

## Notes

[1] As used in this paper, open space refers to undeveloped land which retains most of its natural characteristics, recreation areas such as parks, or forest and agriculture lands.

[2] See Propst and Schmid (1993) for a review of the research on fiscal and economic consequences of various land use planning techniques and strategies.

[3] Nonconsumptive goods are also called nondepletable or nonrival. Economists recognize that these resources can be "congestable," meaning that they are non-consumptive up to some level of use, but become consumptive as increased use degrades the resource and/or reduces user benefits. This is true for many forms of recreation, where crowding can lead to reduced user enjoyment (Dixon and Sherman 1990).

[4] Other forms of nonprivate ownership are possible. In state-property regimes, government owns and controls the resource. Nearly all countries exhibit this type of ownership for some resources, most notably parks and forests (Tietenberg 1996). In "res nullius" regimes, no one has ownership rights. Instead, resources are available on a first-come, first-served basis. This type of ownership,

also called open-access resources, commonly degenerates into the tragedy of the commons described by Hardin (1968).

[5] Common property resources are typically allocated through quotas or administratively-set nominal prices. Markets generally do not develop for public goods because producers cannot exclude non-payers from use (i.e., nonexclusion), leading to the "free-rider" problem. While this is the general result, there are exceptions. Tietenberg (1996) presents The Nature Conservancy's land conservation program as an example of the private provision of public goods (see also Wolf 1981).

[6] Nonexclusion and the subsequent failure of markets to develop also results in the under-production of public goods and common property resources since private landowners are not compensated for production. This is one of the main reasons for public land ownership (Loomis 1993).

[7] A conservation easement, or conservation restriction, is a recorded land use agreement, generally granted in perpetuity, in which the property owner conveys to a governmental unit or charitable organization certain rights (such as the right to develop) to be enforced for the public benefit (Land Trust Alliance and National Trust for Historic Preservation 1990).

[8] Open space or cluster subdivisions contain the same number of individual homes as a conventional development plan, but the lots are downsized and grouped together with the remaining area of the parcel (typically 50% or more of the total) left as permanently-preserved open space.

[9] Bequest value is sometimes recognized as a distinct nonuse value (see Walsh et al. 1984).

[10] Some of the values addressed here are also discussed in other sections of this paper. For example, the value of a nonconsumptive use such as a visually-pleasant landscape will to some extent be capitalized as enhancement value in nearby properties. As such, care should be taken to avoid "double-counting" open space benefits (de Groot 1994).

[11] In some instances, actual hunting and/or recreational user fees from private lands can serve as proxy market values for use on nearby lands without fees, or where nominal fees are administratively determined.

[12] A related measure of value is "willingness to accept." This approach seeks to determine the minimum amount that an individual would need to be compensated in order to do without a resource or service.13 A recreational visitor day (RVD) is a 12-hour time period spent recreating. It could represent one person recreating for 12 hours, or 12 people recreating for one hour each, or any combination thereof (USDA Forest Service 1990b).

## Literature Cited


Ad Hoc Advocates. 1990. The Tax Base and the Tax Bill. Vermont League of Cities and Towns, and Vermont Natural Resources Council, Montpelier, VT. 48 pages.

Adams, V., and B. Mundy. 1991. The valuation of high-amenity natural land. Appraisal Journal (January): 48-53.

Allen, L.R., P.T. Long, R.R. Perdue, and S. Kieselbach. 1988. The impact of tourism development on resident's perceptions of community life. Journal of Travel Research 27: 16-21.

Altshuler, A.A., J. Gómez-Ibáñez, and A.M. Howitt. 1993. Regulation for Revenue: The Political Economy of Land Use Exactions. The Brookings Institution, and The Lincoln Institute of Land Policy, Washington, DC, and Cambridge, MA. 175 pages.

The American Almanac 1993-1994: Statistical Abstract of the United States. 1992. The Reference Press, Austin, TX. 1009 pages.

Anonymous. 1992. "Ask a silly question...": Contingent valuation of natural resource damages. Harvard Law Review 105: 1981-2000.

Benson, J. 1994. On the Economic Contribution of Maine's Natural Resource Industries. Background paper prepared for the Maine State Planning Office, Augusta, ME.

Bishop, R.C. 1987. Economic values defined. Pages 24-33 in Decker, D.J., and G.R. Goff, eds., Valuing Wildlife: Economic and Social Perspectives. Westview Press, Boulder, CO.

Boyle, K.J., S.D. Reiling, and M. Phillips. 1989. Highlights from the survey of 1988 moose hunters. Department of Agricultural and Resource Economics, ARE 392. University of Maine, Orono, ME.

Burchell, R.W., and D. Listokin. 1978. The Fiscal Impact Handbook: Estimating Local Costs and Revenues of Land Development. Rutgers University Center for Urban Policy Research, New Brunswick, NJ. 480 pages.

Burchell, R.W., and D. Listokin. 1980. The Practitioner's Guide to Fiscal Impact Analysis. Rutgers University Center for Urban Policy Research, New Brunswick, NJ. 68 pages.

Burchell, R.W., and D. Listokin. 1992. Fiscal Impact Procedures and the State of the Art: The Subset Question of the Costs and Revenues of Open Space and Agricultural Lands. Rutgers University Center for Urban Policy Research, New Brunswick, NJ. Presented at "Does Land Conservation Pay? Determining the Fiscal Implications of Preserving Open Land," Lincoln Institute of Land Policy, Cambridge, MA.

Burchell, R.W., and D. Listokin. 1995. Land, Infrastructure, Housing Costs and Fiscal Impacts Associated with Growth: The Literature on the Impacts of Sprawl versus Managed Growth. Lincoln Institute of Land Policy working paper, Cambridge, MA.

Burchell, R.W., D. Listokin; and W.R. Dolphin. 1985. The New Practitioner's Guide to Fiscal Impact Analysis. Rutgers University Center for Urban Policy Research, New Brunswick, NJ. 73 pages.

Closser, J.E. 1994. Assessing land under conservation restrictions. Assessment Journal 1(4): 20-24.

Commonwealth Research Group. 1995. Cost of Community Services in Southern New England. Southern New England Forest Consortium, Inc., Chepachet, RI. 102 pages.

Correll, M.R., J.H. Lillydahl, and L.D. Singell. 1978. The effects of greenbelts on residential property values: Some findings on the political economy of open space. Land Economics 54(2): 207-217.

Costanza, R., S.C. Farber, and J. Maxwell. 1989. Valuation and management of wetland ecosystems. Ecological Economics 1: 335-361.

Davis, L.S., and K.N. Johnson. 1987. Forest Management, 3rd edition. McGraw-Hill Book Co., NY. 790 pages.

de Groot, R.S. 1994. Environmental functions and the economic value of natural ecosystems. Pages 151-168 in Investing in Natural Capital: The Ecological Economics Approach to Sustainability. Island Press, Washington, DC.

Dixon, J.A., and P.B. Sherman. 1990. Economics of Protected Areas: A New Look at Benefits and Costs. Island Press, Washington, DC. 234 pages.

Downs, A. 1994. New Visions for Metropolitan America. The Brookings Institution and The Lincoln Institute of Land Policy, Washington, DC and Cambridge, MA. 256 pages.

Duda, M.D., and K.C. Young. 1994. Americans and Wildlife Diversity. Responsive Management, Harrisonburg, VA. 155 pages.

Dupuit, J. 1844. On the measurement of the utility of public works. Pages 255-283 in K.J. Arrow and T. Scitovsky, eds., Readings in Welfare Economics, Volume 12. Homewood Press.

Ebenreck, S. 1988. Measuring the value of trees. American Forests 94(7-8): 30.

Farber, S., and R. Costanza. 1987. The economic value of wetlands systems. Journal of Environmental Management 24: 41-51.

Fay, et al. 1996. Letter to the editor. Valuation Insights and Perspectives 1(3): 41-43.

Freedgood, J., and R.C. Wagner. 1992. Cost of Community Services Studies: Snapshots of Net Fiscal Impacts of Different Land Uses in Towns. Northeastern Office, American Farmland Trust. Presented at "Does Land Conservation Pay? Determining the Fiscal Implications of Preserving Open Land," Lincoln Institute of Land Policy.

Freeman, A. M., III. 1993. The Measurement of Environmental and Resource Values: Theory and Methods. Resources for the Future, Washington, DC. 516 pages.

Hammer, T.R., R.E. Coughlin, and E.T. Horn. 1974. The effect of a large urban park on real estate value. Journal of the American Institute of Planners 40(July): 274-277.

Hanson, W.S. 1996. Public interest value and noneconomic highest & best use: The Appraisal Institute's position. Valuation Insights and Perspectives 1(2): 48.

Hardin, G. 1968. The tradgedy of the commons. Science 162: 1243-1248.

Harms, V. 1994. The National Audubon Society Almanac of the Environment: The Ecology of Everyday Life. G.P. Putnam's Sons, New York, NY.

Hocker, J.W. 1996. Patience, problem solving, and private initiative: Local groups chart a new course for land conservation. Pages 245-259 in Diamond, H.L., and P.F. Noonan. Land Use in America. Island Press, Washington, DC.

Ingerson, A. (ed.) 1995. Managing Land as Ecosystem and Economy. Lincoln Institute of Land Policy, Cambridge, MA. 36 pages.

Irland, L. 1994. Five images of the Maine forest. The Maine Scholar 7(3): 1-12.

Kelsey, T.W. 1993. Fiscal impact of population growth and decline in small communities. American Journal of Agricultural Economics 75: 1169-1173.

Kerlinger, P. 1993. Birding economics and birder demographics studies as conservation tools. Pages 32-38 in Finch, D.M., and P.W. Stangel, eds., Status and Management of Neotropical Migratory Birds. USDA Forest Service General Technical Report GTR-RM-229.

Kerlinger, P., and J. Brett. 1995. Hawk Mountain Sanctuary: A case study of birder visitation and birding economics. In Knight, R., and K. Gutzwiller, eds., Wildlife and Recreationists: Co-existence Through Management and Research. Island Press, Washington DC.

Kerlinger, P. 1995. The economic impact of birding ecotourism on communities surrounding eight National Wildlife Refuges. National Fish and Wildlife Association, Washington, DC.

Kitchen, J.W., and W.S. Hendon. 1967. Land values adjacent to an urban neighborhood park. Land Economics 43: 357-360.

Knox, J.B. 1995. Report of the Commission to Study the Future of Maine's Paper Industry. Office of Policy and Legal Analysis, Maine Legislature, Augusta.

Krutilla, J.V. 1967. Conservation reconsidered. American Economic Review 57: 777-786.

Krutilla, J.V., and A.C. Fisher. 1975. The Economics of Natural Environments: Studies in the Valuation of Commodity and Amenity Resources. Resources for the Future, Washington D.C. 292 pages.

Kusler, J., and L. Larson. 1993. Beyond the Ark: A new approach to U.S. floodplain management. Environment 35(5): 6-16.

Lacy, J. 1990. An Examination of Market Appreciation for Clustered Housing with Permanent Open Space. Center for Rural Massachusetts, Department of Landscape Architecture and Regional Planning, University of Massachusetts, Amherst MA. 14 pages.

Ladd, H. 1992. Effects of Population Growth on Local Spending and Taxes. Lincoln Institute of Land Policy working paper, Cambridge, MA. 53 pages.

Land Trust Alliance and National Trust for Historic Preservation. 1990. Appraising Easements: Guidelines for Valuation of Historic Preservation and Land Conservation Easements, 2nd edition. Land Trust Alliance and National Trust for Historic Preservation, Alexandria, VA and Washington, DC. 82 pages.

Leopold, A. 1949. A Sand County Almanac, with Essays on Conservation from Round River. Oxford University Press. Sierra Club/Ballantine Books edition, 1974, San Francisco, CA and New York, NY. 295 pages.

Loomis, J.B. 1993. Integrated Public Lands Management: Principles and Applications to National Forests, Parks, Wildlife Refuges, and BLM Lands. Columbia University Press, New York. 474 pages.

McElvany, N.D. 1995. Snowmobiling in Vermont: An Economic Impact Study and Snowmobile User Survey. Vermont Association of Snow Travelers, Montpelier, VT.

Nash, R.F. 1989. The Rights of Nature: A History of Environmental Ethics. University of Wisconsin Press, Madison, WS. 290 pages.

National Fish and Wildlife Foundation. 1994. Factsheet: Birding as an Economic Asset. National Fish and Wildlife Foundation, Washington, DC.

New England Governors' Conference, Inc. 1988. Report of the Committee on the Environment. Boston, MA.

Northeastern Forest Alliance. 1990. The Economic Importance of Maine's Forest. Northeastern Forest Alliance, Saranac Lake, NY.

Northeastern Forest Alliance. 1993. The Economic Importance of the Northeast Forest. Northeastern Forest Alliance, Saranac Lake, NY.

Nelson, A.C. 1985. A unifying view of greenbelt influences on regional land values and implications for regional planning policy. Growth and Change 16(2): 43-48.

Paper Industry Information Office. 1994. Maine's Pulp and Paper Industry. Paper Industry Information Office, Augusta, ME.

Parsons, G.R. 1992. The effect of coastal land use restrictions on housing prices: A repeat sale analysis. Journal of Environmental Economics and Management 22: 25-37.

Pizam, A. 1978. Tourism's impacts: The social costs to the destination community as perceived by its residents. Journal of Travel Research 16: 8-12.

President's Commission on Americans Outdoors. 1987. Americans and the Outdoors. U.S. Government Printing Office, Washington, DC. 28 pages.

Propst, L., and M. Schmid. 1993. The Fiscal and Economic Impacts of Local Conservation and Community Development Measures: A Review of the Literature. Greater Yellowstone Coalition, Bozeman, MT. 40 pages.

Rivers and Trails Conservation Assistance. 1995. Economic Impact of Protecting Rivers, Trails and Greenway Corridors, 4th edition. USDI National Park Service, Washington, DC. 150 pages.

RKG Associates. 1989. The Fiscal and Economic Impacts of Growth on the Island of Nantucket, Final Report. Nantucket Land Council.

Roddewig, R.J., and G.R. Papke. 1993. Market value and public value: An exploratory essay. The Appraisal Journal (January): 52-62.

Rolston, H. III. 1988. Environmental Ethics: Duties to and Values in the Natural World. Temple University Press, Philadelphia, PA. 391 pages.

Rose, C. 1994. Given-ness and gift: Property and the quest for environmental ethics. Environmental Law 24(1): 1-31.

Samuelson, P.A. 1973. Economics, 9th edition. McGraw-Hill Book Co., NY. 917 pages.

Small, S.J. 1990. The Federal Tax Law of Conservation Easements, 2nd edition. Land Trust Alliance, Alexandria, VA.

Small, S.J. 1996. Preserving family lands. Land and People (Spring): 14-15. Trust for Public Land, San Francisco, CA.

Smith, V.K. 1993. Nonmarket valuation of environmental resources: An interpretive appraisal. Land Economics 69(1):1-26.

Sorg, C.F., J.B. Loomis, D.M. Donnelly, G.L. Peterson, and L.J. Nelson. 1985. Net economic value of cold and warm water fishing in Idaho. USDA Forest Service, Resource Bulletin RM-11. 26 pages.

Sorg, C.F., and J.B. Loomis. 1984. Empirical estimates of amenity forest values: A comparative review. USDA Forest Service General Technical Report RM-107. 23 pages.

Sorg, C.F., and L.J. Nelson. 1986. Net economic value of elk hunting in Idaho. USDA Forest Service, Resource Bulletin RM-12. 21 pages.

Stevens, T. 1990. The economic value of bald eagles, wild turkeys, Atlantic salmon, and coyotes in New England. Resources and Environment: Management Choices. November report of the Department of Resource Economics, University of Massachusetts, Amherst.

Stirling, A. 1993. Environmental valuation: How much is the emperor wearing? The Ecologist 23(3): 97-103.

Stone, C. 1974. Should Trees Have Standing? - Toward Legal Rights for Natural Objects. William Kaufman, Inc., Los Altos, CA. 102 pages.

Swanson, C.S., M. Thomas, and D.M. Donnelly. 1989. Economic value of big game hunting in southeast Alaska. USDA Forest Service, Resource Bulletin RM-16. 11 pages.

Thibodeau, F.R., and B.D. Ostro. 1981. An economic analysis of wetland protection. Journal of Environmental Management 12: 19-30.

Tietenberg, T. 1996. Environmental and Natural Resource Economics, 4th edition. HarperCollins College Publishers, New York. 614 pages.

Tischler & Associates. 1989. Fiscal Evaluation for Seven Land Use Prototypes for Groton, Connecticut. Tischler & Associates, Inc. Bethesda, MD.

Tischler, P. 1988. Analyzing the Fiscal Impact of Development. International City Management Association, MIS Report 20(7). 18 pages.

United States Congress, Office of Technology Assessment. 1995. The Technological Reshaping of Metropolitan America. U.S. Government Printing Office, Washington, DC. OTA-ETI-643. 232 pages.

USDA Forest Service. 1990a. Income opportunities in special forest products. Agriculture Information Bulletin 666. United States Department of Agriculture, Washington, DC.

USDA Forest Service. 1990b. The Forest Service Program for Forest and Rangeland Resources: A Long-Term Strategic Plan. USDA Forest Service, Washington, DC.

USDA Forest Service. 1995. National survey on recreation and the environment: 1994-1995 key findings. USDA Forest Service, Washington, DC.

United States Department of the Interior. 1993. 1991 National Survey of fishing, hunting, and wildlife-associated recreation. United States Department of the Interior, Washington, DC. 124 pages.

Vicary, B. 1994. Trends in appraising conservation easements. The Appraisal Journal (January): 138-143.

Wagenaar Hummelinck, M.G. 1984. Tidal areas: A blessing in disguise. Environment Features 84-3. Strasbourg: Council of Europe.

Walsh, R., and L. Gilliam. 1982. Benefits of wilderness expansion with excess demand for Indian Peaks. Western Journal of Agricultural Economics 7: 1-12.

Walsh, R., J. Loomis, and R. Gillman. 1984. Valuing option, existence, and bequest demands for wilderness. Land Economics 60(1): 14-29.

Weicher, J.C., and R.H. Zeibst. 1973. The externalities of neighborhood parks: An empirical investigation. Land Economics 49: 99-105.

Weisbrod, B.A. 1964. Collective-consumption services of individual-consumption goods. Quarterly Journal of Economics 78: 471-473.

Weiss, M.A. 1987. The Rise of the Community Builders: The American Real Estate Industry and Urban Planning. Columbia University Press, New York, NY. 228 pages.

Wheeler, D.P. 1996. Ecosystem Management: An Organizing Principle for Land Use. Pages 155-172 in Diamond, H.L. and P.F. Noonan. Land Use in America. Island Press, Washington, D.C.

Wolf, P. 1981. Land in America: Its Value, Use, and Control. Pantheon Books, New York. 590 pages.