

# Input-Output Modeling of Protected Landscapes: The Adirondack Park

*Klaus Hubacek, Jon D. Erickson, and Faye Duchin\**

**Abstract:** Change in ownership of large land resources in the northeastern United States is reshaping the economic and cultural landscape. The Adirondack Park of New York State has taken aggressive steps toward land conservation through public land acquisition and private land planning. The State's decision to either acquire more land for protecting open space, to negotiate conservation easements, or to embrace unrestricted development will influence the region's economic structure for decades. These alternative scenarios are explored with an input-output model including land in physical units. Conservation easements are found to have the most potential to meet target objectives without compromising conservation goals.

## I. LAND OWNERSHIP, ECONOMIC UNCERTAINTY, AND THE ADIRONDACK PARK

The 100-year-old, 6 million acre Adirondack Park of New York State outlined in Figure 1 is the largest park in the contiguous United States. The Park is home to over 135,000 permanent residents, hosts 200,000 seasonal homes, and is within a day's drive of over 60 million people. Nearly one-half of the Park is constitutionally protected as "forever wild" as part of the New York State Forest Preserve, while the remaining acreage is comprehensively zoned for multiple private uses.

Private land is zoned to complement the State Forest Preserve while allowing for opportunities to support the local economies of 105 towns and villages. Heralded as America's first protected wilderness (Schneider 1997), the spawning grounds of the U.S. National Wilderness Act of 1964 (Zahniser 1998), and an extraordinary story of people living within a contested terrain (Terrie 1997), the Adirondack Park has emerged in both the domestic and international conservation policy arena as a 100-year-old trial of sustainable development (McKibben 1995; Weber 1996; Erickson 1998, 2001).

In addition to this prestige as a strong example of land conservation, the Adirondack Park has served as a model for managing environments where people and wilderness can coexist in a sustainable way. This coexistence has been enabled by the combination of protected State and privately owned land regulated by zoning laws. This type of patchwork-quilt park has become a model for sustainability rather than conservation alone, as it allows for a variety of land uses

---

\* School of the Environment, University of Leeds, UK, and International Institute for Applied Systems Analysis, Laxenburg, Austria; School of Natural Resources, University of Vermont, Burlington; and Department of Economics, Rensselaer Polytechnic Institute, Troy, NY. The authors thank Graham Cox, Christina Prell, and all people interviewed and otherwise participating in the project, as well as the referees and managing editors of this Journal for their comments, advice, and assistance.

and the integration of preservation and economic development within a regional entity (Hubacek and Bauer 2000).

FIGURE 1  
Adirondack Park in the Northeast United States



The current state of the Adirondack region of northern New York mirrors much of the 26 million acre Northern Forest—stretching from Lake Ontario to the coastline of Maine. The northern rural economy is characterized by a number of land-use and related economic trends, including:

- (1) The sale and/or subdivision of large land lots previously devoted to forest products industries. For example, over 10 percent of private land within the Adirondack Park boundary has been for sale during the late 1990s (Cox 1998). Much of this land was held by the forest products industry. In Maine, over 2 million acres of forestland was sold in 1998 alone, with less than 2,000 acres earmarked for preservation (Revkin 1998).
- (2) A trend toward tourism-based industries and away from forest-based and extractive industries.
- (3) A shifting land tax base and larger government share of the tax roll. Northeast land sales by Champion International, a multinational pulp and paper company, provide a telling example of these land economic

dynamics. In 1998, Champion brokered a deal with the Conservation Fund (a national not-for-profit group) to conserve over 300,000 acres of forestlands across New York, Vermont, and New Hampshire. The resulting multistate agreement was the largest public-private conservation partnership in U.S. history (Klingbeil 1998). For the over 144,000 acres of Adirondack land, the State of New York decided to add land to the Forest Preserve and to purchase conservation easements allowing for a combination of private tax relief, public access, and sustainable timber harvest. Letting the land fall to the will of the open market was another option, however never publicly considered by the State.

Diverse opinions, different degrees of input from stakeholders, and an us-against-them attitude between environmental groups and local residents have contributed to over 100 years of controversy over Adirondack land resources (Erickson and O'Hara 2000). The largest uncertainty in these land acquisitions and conservation easements has been the regional socio-economic impacts of alternative land ownership and use patterns. The privately held timberland resources of the Park have been used for a variety of purposes, ranging from pulp and paper input, sawtimber, and firewood, to recreational leasing and private parks.

To evaluate alternative scenarios of land reallocation, input-output analysis is used to explore the shifting tax base of Park communities, the changing job market, and the impact on local economies more generally. The analysis is based on an input-output table for eight of the twelve counties all or partially within the Park boundary. The aggregate county economy includes 28 industry sectors, final demand columns for permanent residents, seasonal residents, and tourists, and a matrix of factor inputs—in physical units—for eight different land-use categories derived from a county-level geographical information system (GIS) on Adirondack parcels.

## II. ECONOMIC LANDSCAPE OF THE ADIRONDACK PARK

The spatial expansion of the Adirondack economy is restricted and guided by a central planning agency, the Adirondack Park Agency (APA). In 1971, the APA was created to zone the public Adirondacks for recreation uses and the private Adirondacks for development intensities. Table 1 lists the public and private zoning classifications, percentage of Adirondack land within each category, and a brief description of use intensity by zone. The bulk of other private land restrictions are targeted at wetland and waterfront development and timber harvesting.

While these zoning regulations have supported the open space character of the region, they have in no way halted development and use pressures. Pressures on public land use include: high seasonal recreation demand in tourism centers (for instance, the High Peaks and Lake Placid region, site of the 1932 and 1980 Winter Olympic Games); demand for motorized vehicular access on current and future State land; and periodic appeals to log damaged public forests following wind or ice disturbances. Pressures on private land development include a continued subdivision trend and second-home development demand.

TABLE 1  
State and Private Land Classifications, 1992

APA Classification	% of Park	Compatible Uses
<b>STATE LAND</b>		
Wilderness	17.14	Camping, hiking, canoeing, fishing, trapping, hunting, snowshoeing, ski touring
Primitive & Canoe Wild Forest	1.31	Similar to wilderness uses
	20.95	Similar to wilderness uses with the addition of some motorized vehicle access
Other	7.05	Water (6%), Pending (0.68%), State Administration (0.01%), Historic (0.01%), and Intensive Use (0.33%: for example, ski centers, public campgrounds, developed beaches, boat launching)
Total	46.45	
<b>PRIVATE LAND</b>		
Resource Management	28.06	Forestry, agriculture, game preserves, recreation, very low-density development (42.7-acre average lot size)
Rural Use	17.76	Similar to resource management, low-density development (8.5-acre average lot size)
Low Intensity	4.78	Low-density residential development (3.2-acre average lot size)
Moderate Intensity	1.78	Concentrated residential development (1.3-acre average lot size)
Hamlet	0.95	All uses compatible, no APA development intensity limit
Industrial	0.22	Existing industrial uses (excluding mining), future industrial development
Total	53.55	

Source: Erickson 1998.

These trends led the governor of New York less than 20 years after the 1971 APA Act to commission a study of the *Adirondack Park in the 21st Century* (The Commission 1990). The results of the Commission's study were published in 1990 amidst heated debate over private property rights (Dobbs and Ober 1995; Erickson and O'Hara 2000). The Commission reported that, despite zoning laws, sales of subdivided property in the Park tripled between 1982 and 1985, and then doubled again by 1988. It also estimated that at full build-out there would be over 150,000 houses in resource management and rural use zones (see Table 1 for definitions), and an additional 250,000 homes along shorefronts and roadsides in and around hamlets (The Commission 1990). This scenario was projected to increase the 1990 Park population by fivefold.

This report and its numerous recommendations were never adopted, largely due to a cloud of economic uncertainty hanging over a region already viewed by many local residents as over-regulated. The economic climate in the region is stigmatized with the State's lowest per capita income, the highest percent of people living below the poverty level, and seasonal unemployment rates over 20 percent.

The Park economy can be further characterized as being dependent on government jobs, growing in tourism-related industries, and declining in manufacturing sector employment. For example, in the mid-1990s, one of three jobs in the Park was on the government payroll. In addition, the majority of job growth in the Park has been in lower-wage service and trade industries. Due to the

region's dependence on tourism and outdoor sports, sharp seasonal swings in unemployment rates are commonplace. Other employment limitations in the Park include the lack of cities and a declining industrial base, forcing many residents to find employment outside the Park boundary. With regard to manufacturing employment, many people's livelihoods are tied to a few large firms. Employment in the few remaining paper mills and interdependent wood products industries has been particularly vulnerable to industry cycles and is currently threatened by the liquidation of large timber holdings.

### III. LAND-BASED INPUT-OUTPUT MODEL

The Commission's (1990) study and the Rockefeller report (Rockefeller Institute of Government 1994) provide a good overview of the political and economic trends continuing to shape the Park economy and open space character. However, the linkage between economy and land use has not been properly understood.

To better understand the general character of the Adirondack economy, and how current economic change may be linked to land-use change, the following input-output model supplemented with eight categories of land in physical units was constructed. The land-use data are derived from a county-level geographical information system on Adirondack tax parcels and estimates of final demand for permanent residents, seasonal homeowners, and tourists.

#### **Input-Output Model Overview**

To analyze scenarios involving structural changes in an economy, input-output analysis (I-O) has been the framework of choice. Through an accounting system introduced by Leontief in the 1930s, I-O has been extensively used to quantify the flows of goods and services between economic sectors, final demand, and institutional inputs of national economies. Stone (1970) further expanded the scope of I-O to include the transfer of income between institutions in the Social Accounting Matrix (SAM). With the addition of environmental and natural resource accounts, the I-O framework has also been expanded to describe the relations among economic activity, natural resource use, and pollution impact (see, for example, Victor 1972, United Nations 1993, and Lange 1998).

I-O analysis has often been criticized because the basic I-O relations are represented by fixed coefficients, given a certain period of time. The assumption behind this is that the physical structure does not automatically respond to changes in prices. I-O assumes fixed-proportion (Leontief-type) production functions, which also means that input functions are linear and the marginal input coefficient is equal to the average. These assumptions are not unduly restrictive for a small, open economy with excess capacity throughout. Furthermore, these changes might not be substantial in the short run because of the nature of the technology and the stability of relative factor prices.

At the regional level, the expense and time required to develop a system of accounts has prohibited a large number of regional survey-based I-O tables. As

a result, methodologies were developed to estimate regional I-O tables based on national technology coefficients and on regional employment and income data (Miller and Blair 1985). The most extensively used system of regional accounts in use in the U.S. today is maintained by the Minnesota IMPLAN group. IMPLAN tables can be created for any collection of counties or zip code groups in the U.S. based on national and state databases, and then modified using local data (Olson and Lindall 1996). IMPLAN has proven very useful for this type of analysis, even though it is not designed for the extension with physical indicators of resource use.

Economic impact studies use I-O tables to evaluate changes in final demand and technology and their effects on output, employment, and income in a region. In order to trace the transmission of an impact throughout the economy of exogenously given changes in final demand, the Leontief inverse,  $(I-A)^{-1}$ , is post-multiplied by the vector  $\Delta y$  representing changes in final consumption:

$$(1) \quad \Delta x = (I-A)^{-1} \Delta y .$$

Given constant relationships between labor, business profits, and indirect taxes and output, employment and various income multipliers can also be estimated. For example, employment multipliers ( $\epsilon$ ), indicating the ratio of total employment to direct output, are created by multiplying worker per output ratios ( $w$ ) with the respective output multipliers  $(I-A)^{-1}$ :

$$(2) \quad \epsilon = w(I-A)^{-1} .$$

Income multipliers ( $M^I$ ), translate the impacts of final-demand spending into income received by households. These can be estimated by converting each element ( $a_{ij}$ 's) in a particular column of  $(I-A)^{-1}$  into a dollar's worth of household income via household input coefficient:

$$(3) \quad M^I = \sum_{i=1}^{n+1} a_{n+1,i} \alpha_{ij} .$$

To better understand the dependence of the Adirondack economy on land inputs, a land requirement coefficient vector ( $C_j$ ) was computed as the ratio of total land use in each sector ( $L_j$ ) over total sectoral output ( $X_j$ ):

$$(4) \quad C_j = \frac{L_j}{X_j} .$$

The land requirement coefficient vector ( $C_j$ ) represents land use in acres per million dollars of output of sector  $j$ . This is equivalent to the inverse of sectoral land productivity ( $P_j$ ), which represents the output in millions of dollars produced on one acre of land.

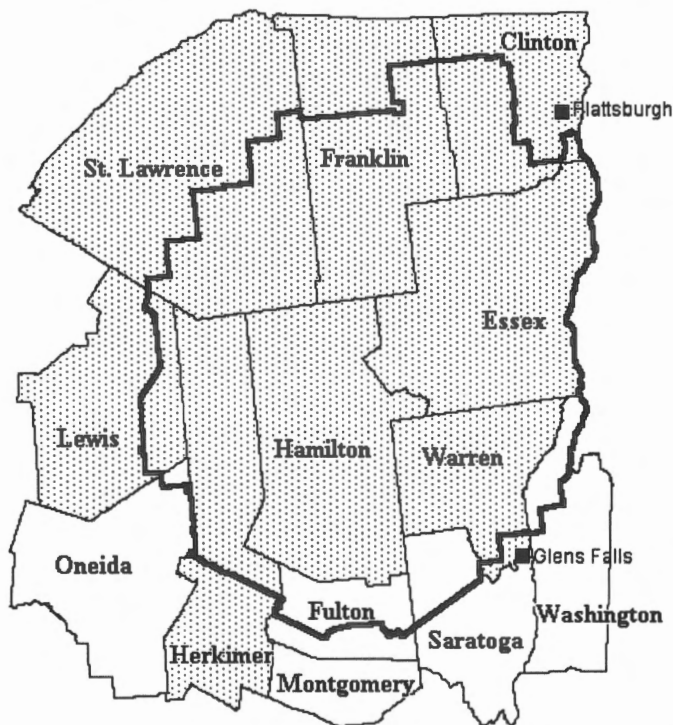
In the short term, producers might be able to expand their output without significant needs for further land, especially in the case of industrial and service

sectors. The link between output and land use is therefore best perceived as a long-run relationship and, as such, subject to technical change.

### The Adirondack Land-Economy Model

To investigate the structure of the Adirondack economy and its dependence on land inputs, an eight-county region was formed to approximate the 1995 Adirondack economy (see Figure 2). A total of 12 counties have land within the Park boundary. However, only two counties are entirely within the Park, and eight counties account for over 80 percent of parklands. The study economy is represented by 267 economic sectors. These were aggregated to 28 sectors in order to match economic activity with land-use data.

FIGURE 2  
IMPLAN County Study Area (shaded) in the Adirondack Park Region



Land use within the Park was estimated from real property assessment data using property-type classification codes. These codes are used to describe the primary use of each parcel of real property on tax rolls. The data, as provided by the APA, categorizes land into more than 200 property tax codes and 15 APA land zone categories. Only land data on seven of the eight study counties were available (Warren County data was not digitized at the time of this study). Property tax codes were matched with the economic sectors and final demand categories to estimate sectoral land use.

A land inventory is shown in Table 2, where each parcel of land is assigned to an APA zone and economic sector. The biggest consumers of land are, not surprisingly, the pulp and paper and forest products industries. The processing sectors and service sectors consume land mainly in the form of built-up land. The tax codes are not specific enough to assign land to each manufacturing sector, so the total land for the Manufacturing and Processing tax code was divided among manufacturing sectors according to their share of the value of output. There is no appropriate tax code for construction activities; therefore, its land uses were included as a manufacturing sector. The APA land data also include information on land use by permanent residents, which was assigned to the household vector. State forestland was assigned to tourism, as many tourist activities depend on public land and watersheds through hiking, fishing, winter sports, nature watching, etc.

TABLE 2  
Full Land Inventory for the Seven-County Region (in acres)

	Hamlet	Industrial Use	Moderate Intensity	Low Intensity	Rural Use	Resource Mgt.	Other	State Land	Total Acreage
Agriculture	530	0	1,150	6,850	23,940	30,040	20	160	62,690
Forestry Products	1,150	1,710	2,090	22,010	158,930	559,130	11,000	19,160	775,180
Mining	250	2,020	220	550	1,350	25,620	0	60	30,070
Construction	380	30	310	0	10	0	30	0	760
Food Processing	260	20	210	0	0	0	20	0	510
Other Manufacturing	210	20	170	0	0	0	20	0	420
Wood Products	80	10	60	0	0	0	10	0	160
Paper & Pulp	1,190	2,120	2,090	22,020	158,930	559,170	11,000	19,160	775,680
Chem./Rubber/Leather	340	30	270	0	10	0	30	0	680
Primary Metals	380	30	310	0	10	0	30	0	760
Fabricated Metals	150	10	120	0	0	0	10	0	290
Machinery	90	10	70	0	0	0	10	0	180
Transport	270	200	0	200	450	800	0	430	2,350
Communications	30	0	30	30	40	40	0	0	170
Utilities	310	0	220	490	4,220	14,960	250	210	20,660
Wholesale	240	0	160	380	260	390	0	0	1,431
Retail	380	0	110	470	130	190	0	0	1,280
FIRE	1,200	0	1,150	2,180	1,270	1,690	0	40	7,530
Eating & Lodging	50	0	10	30	10	0	0	10	110
Other Services	660	0	280	420	660	1,040	0	80	3,140
Recreation	1,700	0	3,940	2,330	6,040	18,380	0	360	32,750
Health Services	140	0	20	0	0	0	0	100	260
Professional Services	10	0	0	0	0	0	0	0	10
Education	620	0	220	690	1,080	17,150	0	280	20,040
Social Services	190	0	280	720	330	1,260	30	0	2,810
Gov't: State & Local	330	0	210	150	310	280	0	150	1,430
Gov't: Federal	40	0	10	160	160	10	0	250	630
Residents	13,290	90	23,650	64,660	159,220	122,990	40	4,140	388,080
Forest Preserve	910	0	5,510	18,580	46,530	104,880	12,960	2,012,470	2,201,840
Vacant Land	10,820	1,330	19,080	53,820	99,530	60,930	760	5,710	251,980
<b>TOTAL</b>									<b>4,583,880</b>

Note: Numbers are rounded to the nearest multiple of 10 acres.

Household demand in the Adirondack economy was separated into demand from permanent residents, seasonal residents, and tourists. Household expenditures based on census data do not include expenditures by seasonal residents from tourism expenditures as separate categories. The column for households with high income, weighted by average length of stay, was used to approximate the final demand column for seasonal residents. Average stay of seasonal residents was assumed to be one month per year.<sup>1</sup> The sum total of final demand

<sup>1</sup>This assumption reflects American Housing Survey data on length of vacancy of seasonal homes on a national level. According to Robert Scardamalia, Chief Demographer with Empire State Development, there is no data on how long seasonal residents stay in the area (personal communication).



was weighted with the average stay of one month and the ratio of seasonal residents to total residents.

With regard to tourist demand, there is no systematic data on the number of tourists and their expenditures available for the Adirondack Park. The most recent figure provided by the Adirondack Tourism Council<sup>2</sup> estimates that 8 to 9 million tourists stay an average of 2 to 2.5 days (16 to 22.5 million visitor-nights), thus we arrive at our more conservative assumption of 17.5 million visitor-nights. Total tourism expenditures are calculated as the product of average expenditure per tourist per day and the estimated number of visitor-days. The total is distributed according to the expenditure shares provided by the 1997 *Domestic Travel Report* (Shifflet & Associates 1997). The report gives average expenditures in dollars and percentage share for the categories of Transport, Food, Room, Shopping, Entertainment, and Miscellaneous.

In addition, the national *Travel and Tourism Satellite Accounts* (TTsAs) were incorporated. The TTsAs are extensions to the U.S. I-O accounts integrating information on the flows of commodities that are related to travel and tourism activities not identified in the standard presentation of I-O accounts (Okubo and Planting 1998).

#### IV. BREAK-EVEN SCENARIO ANALYSIS

Final demand forecasts would be required in order to anticipate how changes in land use affect the local economy. For example, a land-use scenario that favored tourism development would require a forecast of new tourism demand and impact on new and existing tourism-related enterprises. If land ownership shifts from the pulp and paper industry to state land and with it a retirement of productive land, we would have negative impacts on sectoral output that could be offset to some degree by new tourist activities. In analyzing these structural changes in the economy, it is more feasible to estimate the losses of income and employment to the region from the downsizing of the pulp and paper industry than to project the gains from future tourism activity.

The critical issue to the regional economy is whether it is reasonable to expect the beneficial impacts to offset the negative impacts of land-use change. In other words, what would be the break-even levels of jobs and value added required by structural economic change and shifting land uses? A break-even approach to scenario analysis can be used to quantify the level of beneficial activity necessary to offset the reductions in economic activity. The break-even calculation is a straightforward procedure that can be used in the absence of final demand projections. Application of the break-even analysis in an I-O framework can be found in Johnson and Kulshreshtha (1982) and Siegel and Johnson (1991). The approach is similar to estimating final demand when a sector's output is constrained or exogenously given (see Subramanian and Sadoulet 1990; Lewis and Thorbecke 1992; Parikh and Thorbecke 1996; Hubacek and Sun 2001).

<sup>2</sup>Personal communication with Joanne Gowett, Supervisor of the Adirondack Tourism Council, 1999.

Since the objective is to calculate the break-even value of a particular sector's final demand ( $Y_j$ ), it is necessary to reverse the standard formulation of the I-O model to solve for the necessary changes in  $y$  required to achieve a given level of  $x$ . The target output  $X^T$  (where  $T$  indicates target levels) represents the output forgone in the paper and pulp industry due to changes in land use triggered by changing zoning regulations or ownership. This target output is calculated by multiplying the number of acres (denoted  $acres$ ) by the respective land productivity  $P_j$ :

$$(5) \quad X^T = acres \times P_j.$$

The multiplication of the target output by the sectoral ratios of value added ( $V_j$ ) and employment ( $W_j$ ) to total output for the paper and pulp sector gives the target values for value added ( $VA^T$ ) and employment ( $E^T$ ), respectively, measured in annual full-time equivalent jobs:

$$(6a) \quad VA^T = X^T \times V_j,$$

$$(6b) \quad E^T = X^T \times W_j.$$

The break-even levels of final demand  $Y^*$  (where  $*$  indicates break-even levels) can then be calculated by dividing the target values of value added or employment by the respective multiplier for sector  $j$ , where  $\alpha_{ij}^{VA}$  and  $\alpha_{ij}^E$  denote elements of the value-added and employment multiplier matrices, respectively.<sup>3</sup>

$$(7a) \quad Y_j^* = VA^T / \sum_{i=1}^n \alpha_{ij}^{VA},$$

$$(7b) \quad Y_j^* = E^T / \sum_{i=1}^n \alpha_{ij}^E.$$

To calculate the associated employment effects ( $E_j^*$ ) for the break-even final demand ( $Y^*$ ), we multiply  $Y^*$  by the employment multiplier ( $\alpha_{ij}^E$ ):

$$(8) \quad E_j^* = Y_j^* \times \sum_{i=1}^n \alpha_{ij}^E.$$

Similarly, break-even values to a targeted level of employment ( $E^T$ ) in sector  $j$  can be calculated by multiplying break-even final demand with the respective multiplier to yield value added. In cases where several sectors contribute to the output of a specific scenario (as in the case of tourism) the multiplier of each of the tourism subsectors is calculated and weighted by the sectoral contribution to final demand.

### Base-Case Target Levels

To estimate the target levels of output, value added, and employment required by the break-even scenarios, estimates are based on a hypothetical loss of

<sup>3</sup>An alternative way of calculating break-even values is to calculate the sought-after value by iterations.

land from predominately timberland ownership that supported the forest products and pulp and paper industries. In the Adirondack Park, 200,000 acres of private forestland can produce an estimated annual output of \$260 million. Most of the land used for forest-based products is within the most restrictive resource management and rural use zones.

From Equation 5, the target level of output ( $X^T$ ) required to compensate a 200,000-acre loss of land from the pulp and paper sector is \$260 million. This is based on a regional land productivity coefficient ( $p$ ) of \$1,300 of output per acre, based on total output of and total land used by the pulp and paper sector. Reduction in regional employment is estimated to be 1,982 full-time equivalent employees. The total value-added loss—including employee compensation, indirect business taxes, and owner profits—is estimated to be \$113 million. The target levels for both employment and value added are included as the column headings for Table 3, which summarizes the following break-even scenarios.

TABLE 3  
Break-Even Scenarios

Break-Even Levels	Base-Case Target Levels					
	Value Added $VA^T = \$113$ million			Employment $E^T = 1,982$ employees		
	Scenario: Subdivide Wilderness Easement			Scenario: Subdivide Wilderness Easement		
Final Demand, $Y^*$ (millions)	\$ 119	\$ 116	\$ 48	\$ 83	\$ 60	\$ 25.2
Value Added, $V^*$ (millions)	\$ 113	\$ 113	\$ 113	\$ 78	\$ 59	\$ 24.5
Employment, $E^*$ (persons)	2,850	3,804	1,589	1,982	1,982	1,982
New Tourist-Days (millions)	—	1.77	0.74	—	0.93	0.386
New Tourists (% of total)	—	771,125 (8.0%)	297,009 (3.4%)	—	370,582 (4.2%)	154,778 (1.8%)
New Permanent Households (% of total)	2,490 (1.3%)	—	—	1,732 (0.9%)	—	—
New Seasonal Households (% of total)	34,881 (17.4%)	—	—	24,266 (12.1%)	—	—

**Break-Even Scenario: Subdivision**

The first scenario is based on the assumption that available land classified as resource management and currently used as land for paper and pulp production could be subdivided to meet future housing demand from seasonal and permanent residents. The scenario meets target levels once all of the new households have been added to the regional economy. In this scenario, initial one-time costs attributable to construction activities are not included. Injections into the economy are created by final demand expenditures from new seasonal households. These seasonal expenditures are then responsible for creating employment in the region

that requires new 12-month resident households. New permanent household expenditures are included in the indirect rounds of expenditures in the induced demand portion of the Type II multiplier. Only permanent residents are assumed to contribute to the regional employment pool at an average of 1.14 workers per household.

Under this scenario, meeting the base-case target value added would require new expenditures from approximately 35,000 seasonal households. This is about 17.4 percent of the current seasonal households for the entire region. New regional employment would require nearly 2,500 permanent households. Spread over 200,000 acres, this implies an average lot size of approximately five acres, which is well below the resource management zoning of 42.7 acres. Effectively, to meet target value added would require rezoning large tracts of land to a low-intensity zone with an average lot size of 3.2 acres (for the definition of zones and their use, please refer to Table 1).

To meet the less-ambitious target levels for employment requires fewer seasonal residents. The employment target requires approximately 24,000 seasonal households and 1,700 permanent households. This scenario assumes an eight-acre average lot size, still well below resource management zoning. Despite explicitly targeting lost employment, the value-added target results in nearly 1,000 more full-time equivalent workers.

Reaching either of the target values under a subdivision scenario is not feasible given current zoning laws. If 200,000 acres were built out according to the required 42.7 acres per lot, then this scenario could only meet 58 and 70 percent of target levels for value added and employment, respectively.

### **Break-Even Scenario: State Land Acquisition**

Under a second scenario, it is assumed that all available land is added to the Adirondack Forest Preserve, increasing the state ownership in the Park to roughly 50 percent. State land is the main attraction for recreation activities such as hiking, fishing, hunting, canoeing, and sightseeing. An increase in recreational land could attract additional tourists to the area. The principal break-even question is: what amount of final demand generated by new recreational use is needed to make up for the loss in pulp and paper production?

To meet target levels of value added or employment requires break-even final demand levels of \$116 million or \$60 million, respectively. Given average expenditures of \$65 per tourist per day and an average stay of 2.5 days, some 711,000 additional tourists are needed to maintain the present level of regional value added, approximately 8 percent of current Park-wide estimates. Given the high employee per output ratios of the tourism sectors, some 370,000 new tourists (a 4 percent increase) are projected to meet the base-case target level of employment. However, given low value-added contributions of tourism jobs, the 1,982 jobs generated by this new tourism final demand can only generate \$58.7 million in value-added income. This is roughly half of the value-added income assumed

to be lost under the base case. To replace base-case value-added income would require nearly twice the number of new tourists.

Recent growth in tourism is difficult to estimate, has been very location-specific within the Park, and is dependent on a variety of factors, e.g., the U.S. to Canadian dollar exchange rate. In addition, the majority of state land is still not conveniently accessible to most tourists (Dawson, Alberga, and Washburn 1994). The recreational use of new state land acquisitions depends on appropriate infrastructure based on management plans. In the absence of the necessary infrastructure, it remains to be seen if remote portions of the Park (particularly where large timber tracts have been put up for sale in recent years) could attract the number of tourists required to break even under this scenario. New visits to these areas could also come from tourists who already visit other portions of the Park on a yearly basis, resulting in a slight reallocation of expenditures within the region but no net increase in tourism expenditures required to break even.

### **Break-Even Scenario: Conservation Easement**

Under this scenario, the use of conservation easements for the purchase of development rights is taken into consideration. Under a conservation easement, it is assumed that land can continue to contribute to the forest products sector, however at only 70 percent of the output per acre ratio. This reduction is due to restrictions from new management plans that provide for recreation access. In addition, only 80 percent of the 200,000 acres are assumed available to forest production, as areas such as river corridors and public access sites are permanently removed from forest production. To break even, the losses from reduced output can be met by increased tourism demand. Effectively, the target levels are reduced since portions of the targets are met by continued forest products activity.

This scenario results in break-even levels of tourists that total approximately 297,000 and 155,000 to meet target levels of value added and employment, respectively. These levels of new tourists are about 60 percent lower than the break-even values required under complete state land acquisition assumed in scenario 2. The working forest scenario requires increases over current Park tourist visits of 3.4 and 1.8 percent, respectively.

## **V. CONCLUDING REMARKS**

During the last two to three decades, development pressure on the Adirondack Park of New York State has been increasing rapidly. This pressure has been compounded by the decreasing importance of the traditional extraction sectors, especially the forestry and paper and pulp industries. With the decline or reorientation of these sectors, enormous amounts of land have been for sale and open for various development options. Heated public discussions have resulted on whether these lands should be acquired by the State and added to the constitutionally protected Forest Preserve, or whether they should be subdivided and developed. At the center of these debates has been the question of the benefits and costs of various development scenarios.

A break-even analysis within an I-O framework was used to evaluate the effects of alternative scenarios about changing uses of land, shifting from forestland to either protected land or subdivision, and their related effects on value added and employment in the Adirondack Park communities. Break-even analysis has proven useful in this case, where alternative scenarios about the development of certain sectors are difficult to quantify. In the Adirondack case study, it is very speculative to estimate the additional tourism created by an enlargement of wilderness areas. This is particularly true since tourism might be redirected from the tourism centers to less frequent parts of the Park, leading to a redistribution of tourists over the whole region. Furthermore, wilderness areas cannot easily be "consumed" by a large number of tourists without appropriate infrastructure, trail maintenance, and information about the new locations. Break-even analysis allows the calculation of the number of tourists or seasonal residents necessary to replace the losses created by the declining forestry sector.

The break-even model is admittedly static. It does not consider dynamic adjustments of technology or land-use intensity within sectors in response to changing land ownership patterns or accompanying changes in relative input prices. Part of this is due to data limitations on capital investment, but in part these dynamics were viewed as beyond the scope of this project. The scenarios driving final demand would lead to reallocation of land, labor, and capital within the regional economy; however, the small size of the economy and the large presence of institutional buyers of large parcels places less emphasis on price dynamics. In this particular case, the increasing supply of land was absorbed by large institutional buyers such as NGOs, pension funds, and the State, a fact that has kept land prices in check.

Of the three scenarios considered, a working forest conservation easement requires the least amount of additional final demand to replace the target values. This is due to the combination of continuing forest-based manufacturing output and tourism use. The short-run productivity losses due to a new management regime and areas set aside for undisturbed ecological succession are more easily replaced than in the wilderness scenario, where all of the land is taken out of forest use.

The working forest scenario is similar to an agreement reached during the course of this research on the sale of Champion International's timberlands. Rather than purchase the total acreage, New York State opted to acquire 29,000 acres of river corridors and to purchase a conservation easement on 110,000 acres of timberland. This arrangement provides for continued material inputs to the regional timber economy, as well as opportunities to expand recreation into underutilized regions of the Park.

These recent developments in the Adirondack Park, exemplified by the Champion International Paper sale, have been perceived as an opportunity to diversify the region's economy. A true working forest that supports both a recreation-based and timber-based economy offers an opportunity for sustained economic livelihoods, for offsets to the typical boom 'n' bust patterns of a pure timber economy, for development of higher-end value-added wood products manufacturing,

and for private land management that is complementary to conservation goals inherent to neighboring state land.

## REFERENCES

- Commission on the Adirondacks in the Twenty-First Century (The Commission). *The Adirondack Park in the Twenty-First Century*. Albany: State of New York, 1990.
- Cox, G.L. "Protecting the Forest Lands as a Renewable Economic Base for the Adirondack Park." Master's thesis, Rensselaer Polytechnic Institute, 1998.
- Dawson, C, K. Alberga, and M. Washburn. "Recreation and Tourism Participation and Demand in the Adirondack Park: An Assessment of the Limited Information Available for Planning and Management." Draft Report. Albany, N.Y.: New York State Department of Environmental Conservation, 1994.
- Dobbs, D., and Richard Ober. *The Northern Forest*. White River Junction, Vt.: Chelsea Green Publishing Company, 1995.
- Erickson, J.D. "In Search of Sustainable Development: Lessons in Application from the Adirondack Park." In J. Köhn, J.M. Gowdy, and J. van der Straaten (eds.) *Sustainability in Action: Sectoral and Regional Case Studies*. Cheltenham, UK: Edward Elgar, 2001.
- \_\_\_\_\_. "Sustainable Development and the Adirondack Experience." *Adirondack Journal of Environmental Studies* 5 (2) (1998), 24-32.
- Erickson, J., and S. O'Hara. "From Top-Down to Participatory Planning: Conservation Lessons from the Adirondack Park, NY, USA." In L. Tacconi (ed.) *Biodiversity and People: An Ecological Economic and Participatory Approach*. London: Earthscan, 2000.
- Hubacek, K., and W. Bauer. "Conservation and Social Discourse Processes: An Example from Austria." In J. Köhn, J.M. Gowdy, and J. van der Straaten (eds.) *Sustainability in Action: Sectoral and Regional Case Studies*. London: Edward Elgar, 2000.
- Hubacek, K., and L. Sun. "A Scenario Analysis of China's Land Use Change: Incorporating Biophysical Information into Input-Output Modeling." *Structural Change and Economic Dynamics* 12 (4) (2001), 367-97.
- Johnson, T.G., and S.N. Kulshreshtha. "Exogenizing Agriculture in an Input-Output Model to Estimate Relative Impacts of Different Farm Types." *Western Journal of Agricultural Economics* (December 1982), 187-98.
- Klingbeil, A. "Paper Company to Sell Adirondack Land." *The Saratogian*, 10 December 1998, 1A, 9A.
- Lange, G. "From Data to Analysis: The Example of Natural Resource Accounts Linked with Input-Output Information." *Economic Systems Research* 10 (1998), 113-34.
- Lewis, B.D., and E. Thorbecke. "District-Level Economic Linkages in Kenya: Evidence Based on a Small Regional Social Accounting Matrix." *World Development* 20 (6) (1992), 881-97.
- McKibben, B. *Hope, Human and Wild: True Stories of Living Lightly on the Earth*. Boston: Little, Brown, and Co., 1995.

- Miller, R.E., and P.D. Blair. *Input-Output Analysis: Foundations and Extensions*. Englewood Cliffs, N.J.: Prentice-Hall, 1985.
- Okubo, S., and M.A. Planting. *U.S. Travel and Tourism Satellite Accounts for 1992. Survey of Current Business*. Washington, D.C.: Bureau of Economic Analysis, U.S. Department of Commerce, 1998.
- Olson, D., and S. Lindall. *IMPLAN Professional Software, Analysis, and Data Guide*. Stillwater, Minn.: Minnesota IMPLAN Group, Inc., 1996.
- Parikh, A., and E. Thorbecke. "Impact of Rural Industrialization on Village Life and Economy: A Social Accounting Matrix Approach." *Economic Development and Cultural Change* 44 (2) (1996), 351-77.
- Revkin, A.C. "Deal to Open Northeast Land to Public." *New York Times*, 10 December 1998.
- Rockefeller Institute of Government. "Employment and Payrolls in the Adirondack Park." Albany, N.Y.: Rockefeller Institute of Government, State University of New York and New York State Department of Labor, Research & Statistics, 1994.
- Schneider, P. *The Adirondacks: A History of America's First Wilderness*. New York: Henry Hold and Co., 1997.
- Shifflet & Associates. *1997 New York State Domestic Travel Report*. Albany, N.Y.: New York State Department of Economic Development, 1997.
- Siegel, P.B., and T.G. Johnson. "Break-Even Analysis of the Conservation Reserve Program: The Virginia Case." *Land Economics* 67 (4) (1991), 447-61.
- Stone, R. "Demographic Input-Output: An Extension of Social Accounting." In A.P. Carter and B.A. Carter (eds.) *Contributions to Input-Output Analysis*. Amsterdam: North-Holland Publishing, 1970.
- Subramanian, S., and E. Sadoulet. "The Transmission of Production Fluctuations and Technical Change in a Village Economy: A Social Accounting Matrix Approach." *Economic Development and Cultural Change* 39 (1) (1990), 131-75.
- Terrie, P.G. *Contested Terrain: A New History of Nature and People in the Adirondacks*. Syracuse, N.Y.: The Adirondack Museum/Syracuse University Press, 1997.
- United Nations. *Handbook of National Accounting: Integrated Environmental and Economic Accounting. Studies in Methods*. New York: United Nations, 1993.
- Victor, P.A. *Pollution: Economy and the Environment*. Toronto: University of Toronto Press, 1972.
- Weber, B. "The Adirondacks in Global Perspective: A Long-Standing and Ideally Imperfect Model of Multiple-Use Management in a Forest Environment." Paper presented at the Third Annual Conference on the Adirondacks, Raquette Lake, N.Y., 1996.
- Zahniser, E. "The Adirondack Roots of America's Wilderness Preservation Movement." *Adirondack Journal of Environmental Studies* 5 (1) (1998), 14-18.