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ANALYSIS

Estimates of the Genuine Progress Indicator (GPI) for Vermont, Chittenden County and Burlington, from 1950 to 2000

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Abstract

The Genuine Progress Indicator (GPI), a version of the Index of Sustainable Economic Welfare (ISEW), is a significantly more comprehensive approach to assessing economic progress than conventional measures like gross domestic product (GDP). GPI adjusts for income distribution effects, the value of household and volunteer work, costs of mobility and pollution, and the depletion of social and natural capital. ISEW or GPI have been estimated for several countries around the world and a few Canadian provinces, but we report here on the first multi-scale application at the city, county and state levels in Vermont, USA. We show that it is feasible to apply the GPI approach at these smaller scales and to compare across scales and with the national average. Data limitations and problems still exist, but potential solutions to these problems also exist. All three Vermont scales had significantly higher GPI per capita since 1980 than the national average, indicating the major differences that can exist within countries. The GPI per capita for all Vermont scales was similar to the national average in the 1950–1980 period, but more than twice the national average by 2000. The main factors explaining this difference had to do with Vermont's much better environmental performance than the national average in the post-1980 period.

Keywords: Genuine Progress Indicator; Index of Sustainable Economic Welfare; Gross domestic product

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1. Introduction

"*The gross national product does not allow for the health of our children, the quality of their education or the joy of their play. It does not include the beauty of our poetry or the strength of our marriages, the intelligence of our public debate or the integrity of our public officials. It measures neither our wit nor our courage; neither our wisdom nor our learning; neither our compassion nor our devotion to our country; it measures everything, in short, except that which makes life worthwhile. Robert F. Kennedy, 1968*"

Cities, counties and states need indicators of their performance that can tell them something about the larger ecological and social dimensions of human communities, and the sustainability of their activities. They need metrics that go beyond the standard economic indicators like gross national product (GNP) or gross domestic product (GDP),[1] but they also need indicators that can bring all of the disparate economic, environmental and social elements into a common framework and tell them whether they are making real, net progress.

While measures of marketed economic activity like GDP are the most commonly used measures of performance at the national and state levels, they do not serve this purpose well. GDP measures marketed economic activity or gross income. It was never intended as a measure of economic or social welfare, and thus functions very poorly as such (Daly and Cobb, 1989; Costanza et al., 2001). Yet, it is inappropriately used as a national and state welfare measure in far too many circumstances. This same inappropriate use of GDP and related measures occurs at all spatial scales, from global to national to state, county and city, with an uncritical equation of good performance with high levels of marketed economic activity.

The well-known problems with GDP as an economic welfare measure (Daly and Cobb, 1989; Lawn, 2003) include the following. First, it counts everything as a positive. It does not separate desirable, economic welfare-enhancing activity from undesirable welfare-reducing activity. For example, an oil spill increases GDP because someone has to clean it up, but it obviously detracts from our overall well-being. From the perspective of GDP, more crime, sickness, war, pollution, fires, storms and pestilence are all potentially good things, because they all generate economic activity in the formal market. Second, GDP leaves out many things that *do* enhance welfare but are outside the market. For example, the unpaid work of parents caring for their own children at home does not show up, but if these same parents decide to work outside the home and to pay for child care, GDP increases. The non-marketed work of nature in providing clean air and water, food, natural resources and other ecosystem services do not adequately show up in GDP. However, if those services are damaged and we have to pay to fix or replace them, then GDP will increase. Third, GDP does not account for the distribution of income among individuals. But it is well-known that an additional US$1 worth of income produces more welfare if one is poor rather than rich.

Several researchers have proposed alternatives that try to separate the positive from the negative components of marketed economic activity, add in non-marketed goods and services, and adjust for income-distribution effects. These include the Measure of Economic Welfare (MEW—Nordhaus and Tobin, 1972), the Index of Sustainable Economic Welfare (ISEW—Daly and Cobb, 1989), Redefining Progress' more recent variation of ISEW, the Genuine Progress Indicator (GPI—Anielski and Rowe, 1999, see also www.rprogress.org/projects/gpi/) and another variation of ISEW, the Sustainable Net Benefits Index (SNBI—Lawn and Sanders 1999). The ISEW or GPI have been estimated for a number of countries worldwide, as shown in Fig. 1, and for a few Canadian provinces, but had not been estimated for a US state, county or city.

This report is a first attempt to estimate the GPI at these smaller spatial scales for comparison with national level estimates. We estimated GPI for the state of Vermont, Chittenden County (the county with the largest population in the state) and for Burlington (Vermont's and Chittenden County's largest city).

2. Methods

We followed the methods used by Redefining Progress in estimating the GPI to the extent possible. These methods are detailed in several reports

[1] GDP measures marketed economic activity from domestically located assets. GNP measures marketed economic activity from domestically owned assets.

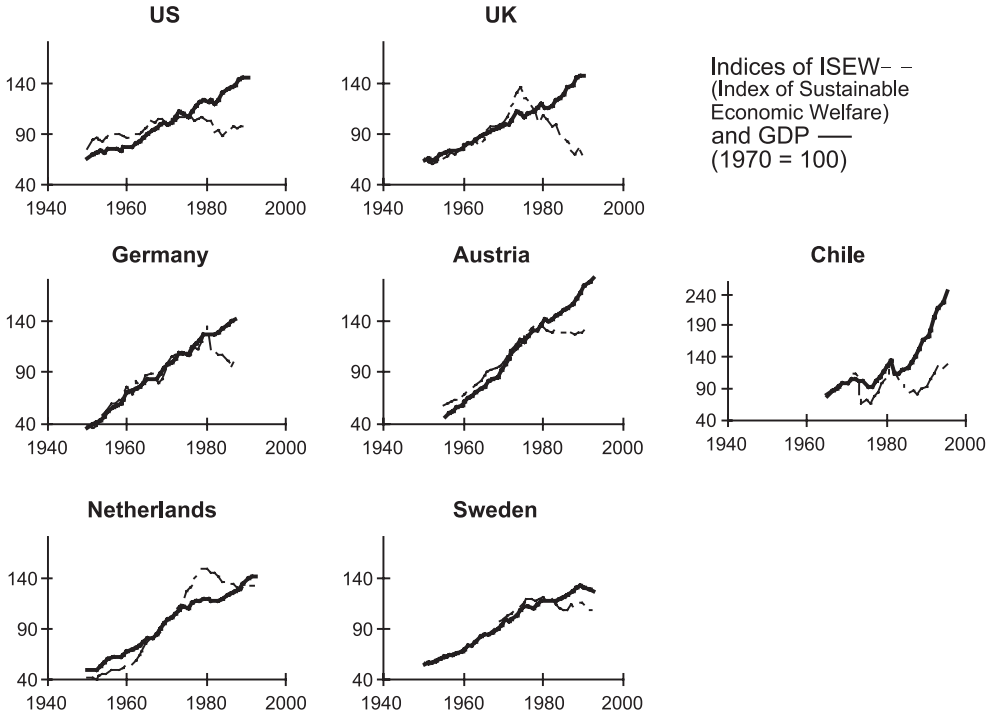

Fig. 1. Indices of ISEW (an earlier version of GPI) and GDP for selected countries (Costanza et al. 1997a,b).

available at their website (http://www.rprogress.org/) and in particular in Anielski and Rowe (1999). This also allowed the maximum degree of consistency with the national GPI estimates for comparison. These methods for GPI estimation are slight variations on the methods described in Daly and Cobb (1989) for estimating ISEW. Table 1 is a summary description of the 26 elements of the GPI, how they are calculated in general and the basis of the regional estimates. The GPI starts with personal consumption expenditures (column A), which are adjusted for distribution of income (column B) to yield adjusted personal consumption (column C). Next, follow a series of additions that estimate non-marketed positive benefits (columns D–G) ranging from the value of unpaid household work to the services of highways and streets. These are followed by a list of subtractions (negative values are in parentheses—in columns H–X). Ranging from losses of social capital (i.e. column H—cost of crime, column I—cost of family breakdown and divorce, column J—loss leisure time and column K—cost of underemployment) to losses in natural capital (i.e. column U—depletion of non-renewable resources, column V—long-term environmental damage and column W—cost of ozone depletion). Finally, there are two columns (Y and Z) that deal with net investment and net "foreign" lending and borrowing, which can be either positive or negative.

The work reported on here was produced as part of a problem-based upper level undergraduate and graduate course held at the University of Vermont in the fall semester of 2003. Pairs of students were assigned related groups of columns in the GPI and worked through the various data collection and scaling problems for their columns. We had weekly meetings to discuss interim findings and problems. After the end of the course, we continued to check and correct the estimates.

Operationally, we divided the overall GPI index into eight functional groups, shown below, along with the students responsible for estimating the elements of each group:

- Income (columns A, B, C)
  Karen Fligger, Alan Adams and Tyson Kerr

Table 1
Description of the main elements of the GPI and the basis of their regional estimates

GPI column	Contribution	Summary of calculation	Basis of regional estimates
A: Personal consumption expenditures	Base value	(Per capita personal income for each scale)×(ratio of personal consumption expenditure to personal income based on national data)	BEA data on per capita personal income available for VT (1950–2000) and CC (1970–2000). CC (1950–1960) calculated based on ratio of CC to VT in 1970. BT calculated by multiplying ratio of BT annual average wage to CC annual average wage based on local data (Center for Rural Studies) to CC per capita personal income.
B: Income distribution	Negative or positive	(Gini coefficient in year times 100)/(base year [1970] Gini coefficient)	Data available for all years for all three levels.
C: Personal cons. adj. for income inequality	Adjusted base value	(Column A/column B)*100	Calculated
D: Value of household labor	Positive	(Hours spent on housework by gender)×(hourly wage for maids, housecleaners and cleaners)	Eisner (1989) estimates scaled by population for 1950–1980. For 1990–2000, Eisner's estimate of hours spent on housework used as base; wage rates averaged from BLS national mean 1990 wage for laundry, cleaning and garment services and VT 2001 wage for maids, housekeepers and cleaners.
E: Value of volunteer work	Positive	(Volunteer hours)×(average hourly wage rate)	Volunteer hours estimate based on education level (U.S. Department of Labor, 2002). Average hourly wage rate calculated as per capita personal income for VT and CC (from BEA) divided by 2000 hrs. For BT, CC hourly wage was used.
F: Services of household capital	Positive	(Cost of consumer durables [column L])×(depreciation rate of 12.5%)	See column L for details on cost of consumer durables. Depreciation rate estimated as 12.5% based on a fixed rate of 8 years.
G: Services of highways and streets	Positive	(Total expenditures for streets and highways)×(7.5% annual value)	Total expenditures data from VT DOT, US DOT and BT. The 7.5% annual value assumes that 10% of net stock is the annual value and 75% of all miles driven are for pleasure.
H: Cost of crime	Negative	(Direct cost of crime [out-of-pocket expenditures and the value of stolen property])+(indirect [defensive expenditures to prevent or avoid crime])	Average cost per crime estimated by dividing value of stolen property (Vermont Center for Justice Research, 2001) by no. of property crimes (FBI, 2000). This cost was multiplied by the no. of property crimes in 1950–2000 (FBI, 1950/1960/1970/1980/1990, 2000). CC and BT scaled by population. Indirect costs scaled from national GPI figures by % households.
I: Cost of family breakdown	Negative	(Cost of divorce)+(social cost of television viewing)	Cost of divorce: no. of divorces in VT (Census Bureau). Cost est. at US$8922/divorce plus US$13,380/child. Est. 0.89 children per divorce. Scaled VT est. by pop. for CC and BT. Cost of TV viewing: time spent watching television by families (h/day/household)×(365 days)×(no. of family households at each scale)×(0.5−the proportion of family households with children)×(US$0.54/h)×(% of households with televisions in each decade).
J: Loss of leisure time	Negative	(Employment level)×(estimated lost leisure hours)×(average hourly wage rate)	Employment level available from BLS. Estimated lost leisure hours: national GPI scaled down by population (see Leete-Guy and Schor, 1992). Average hourly wage: see column E.
K: Cost of underemployment	Negative	(Total number of underemployed persons)×(unprovided hours per constrained worker (Leete-Guy and Schor, 1992))×(average hourly wage rate)	No. of underemployed persons calculated using a data from BLS and Schor (1997) using a quadratic equation to est. underemployment rate from unemployment rate. Unprovided hours used data from Leete-Guy and Schor (1992). Average hourly wage: see column E

Table 1 (*continued*)

GPI column	Contribution	Summary of calculation	Basis of regional estimates
L: Cost of consumer durables	Negative	(Per capita pers. inc. for each scale)×(ratio of consumer durables to personal income from national data)	Personal income levels were again used as the starting point. Then, a ratio of personal income to consumer durables was determined from national data (BEA). We assumed this ratio to also be true for Vermont. It was multiplied times personal income at each time and geographic scale to determine the cost of consumer durables.
M: Cost of commuting	Negative	(Direct costs for vehicle purchase and maintenance)+(cost of public trans.)+ (indirect cost for lost time)	Direct costs: for VT, no. of new vehicles registered in each decade obtained from VT DMV. For BT and CC, scaled VT no. by pop. Multiplied no. of vehicles by ave. purchase price of new vehicles from National Automobile Dealers Assoc. (for cars and trucks) and Cycle World 2000 Buyers Guide for motorcycles. Earlier decades' prices extrapolated based on trend from American Automobiles Manufacturers Assoc. Cost of Public Transportation: Based on operating costs of all public transportation agencies in VT. For CC, summed 2000 operating costs of CCTA and SSTA. For BT, CC total scaled by pop. Previous decades est. based on trend from 1996 Motor Vehicle Facts and Figures (~25% increase/decade) and founding dates of agencies. Indirect costs for 1990 and 2000 were calculated by doubling aggregate daily commuting time to work for workers 16 years and over from the Census multiplying it times a reduced average hourly wage rate (to be consistent with the National GPI) times a 250-day work year. Previous decades were extrapolated based on a trend from the American Automobile Manufacturers Association trend of total miles travels nationally.
N: Cost of household pollution abatement	Negative	(Automobile emission abatement expenditures)+(septic system installation and cleaning costs)+ (solid waste disposal costs)	Automobile emission abatement expenditures after 1977 were assumed to be the cost of a catalytic converter (US$100) times the no. of cars and trucks. Prior to 1977, they are assumed to be zero. Septic system installation and cleaning costs: For 1960–1990, the no. of houses on septic, sewer and no hook-up were counted in the Census. For sewers, no. of houses times cost of sewage charged by BT Public Works Dept. average family output of 12,000 ft^2 (Adams, 2003). For septic, cost was est. based on the no. of houses on septic, US$4000 for installation and a US$200 cleaning cost/5 years. Solid waste disposal costs: The amount of waste per capita was available for VT for 2000. To calculate other years, this figure was multiplied times % change in waste nationally from EPA times population at each scale times % of residential waste (0.60) (EPA) times US$100/ton (Franklin Associates, 1997).
O: Cost of automobile accidents	Negative	(Direct costs, including property damage and healthcare exp.)+ (indirect costs, including lost wages, pain and suffering)	No. of fatalities from automobile accidents (National Safety Council) times cost of all motor vehicle crashes on a per death basis—US$4.68 million (National Safety Council)

(continued on next page)

Table 1 (*continued*)

GPI column	Contribution	Summary of calculation	Basis of regional estimates
P: Cost of water pollution	Negative	(Total benefit of unimpaired water (Freeman, 1982))×(percentage of impaired waters (VT Agency of Natural Resources, 2002))	
Q: Cost of air pollution	Negative	(Scaled down national air pollution damage est. (Freeman, 1982))× (Pollution Standard Index (PSI) value)	National GPI method followed. PSI values used for Vermont. Valuations also scaled to Vermont data, for instance...
R: Cost of noise pollution	Negative	(World Health Organization's (WHO) noise pollution damage estimate (Congressional Quarterly, Inc. 1972))×(urbanization index values)	WHO est. for noise pollution was US$14.62 million. Urbanization index was created by dividing the urban population at each scale by national urban figure for that year.
S: Loss of wetlands	Negative	Cumulative totals based on (est. loss of wetlands)×(acre value)×(inflation value to reflect scarcity)	Estimates of Vermont's wetlands at statehood... wetlands surveys done in 1950s, ..., 1970s, and ... trends extrapolated and applied to various scales. National GPI method used for valuation, including a scarcity factor.
T: Loss of farmland	Negative	Cumulative totals based on (urbanization rate)×(estimated value of farmland per acre)	
U: Depletion of nonrenewable resources	Negative	(Oil consumption levels in barrel equivalents)×(estimated cost of replacing one barrel of oil with a renewable resource)	VT nonrenewable energy consumption data obtained for 1960–1990 from Energy Information Administration (1999) was converted to barrel equivalents and multiplied by the per barrel cost of ethanol (US$109.17). CC and BT numbers were scaled by pop.
V: Long-term environmental damage	Negative	Cumulative totals based on (oil consumption levels in barrel equivalents)×(per barrel oil tax)	VT energy consumption data obtained for 1960–1990 from Energy Information Administration (1999) was converted to barrel equivalents and multiplied by a US$2.56 tax.
W: Cost of ozone depletion	Negative	Cumulative totals based on (per capita ozone loss)× (cost per kilogram)	Per capita ozone loss was determined by multiplying the amount of CFC-11 and CFC-12 (Alternative Flurocarbons Environmental Acceptability Study, 1998) by the US pop. The cost is determined by multiplying the per capita value by the pop. at each scale per decade by US$61/kg (Anielski and Rowe, 1999).
X: Loss of forest cover	Negative	Loss in all forest, calculated by multiplying (change in forest cover)× (value est. for temperate and boreal forests (Costanza et al., 1997a,b))	
Y: Net capital investment	Positive or negative	Scaled down national GPI figures based on population	Scaled down national GPI figures based on population
Z: Net foreign lending and borrowing	Positive or negative	Not included due to the difficulty of accurately collecting relevant data at scales smaller than the national level	Not included due to the difficulty of accurately collecting relevant data at scales smaller than the national level

Abbreviations: BEA: U.S. Bureau of Economic Analysis, BLS: U.S. Bureau of Labor Statistics, BT: Burlington, CC: Chittenden County, DOT: Department of Transportation, VT: Vermont.

- Households (columns D, E, F, L, N)
  Kendra Schmiedeskamp and Jessica Hike
- Mobility (columns G, M, O)
  Christian Adams and Keith Montone
- Social capital (columns H, I, J, K)
  Walter Tusinski and Lauren Sparacino
- Pollution (columns P, Q, R)
  Benjamin Altschuler and Stephanie Balter

- Land loss (columns S, T, X)
  Brendan Fisher and Joseph Kelly
- Natural capital (columns U, V, W)
  Megan McCauley and Michael Rauch
- Net investment (columns Y, Z)
  Dan Saxton and Laurel Williams

Details of the estimates for each column are given in the full report, available for download at http://www.uvm.edu/giee. Karen Fligger was responsible for final checking and editing of the full report.

GPI is calculated as the sum of columns C through Z. Our data collection efforts yielded reasonable estimates for all columns except column Z, net foreign lending and borrowing. The data for column Z for the three Vermont scales allowed us to calculate "foreign" (i.e. outside the area) borrowing, but not lending (for which we were unable to assemble reasonable data at these scales). This omission dramatically skews the results, so we decided to leave column Z out of the GPI index altogether, at least until we can find a way to estimate data on "foreign" lending at these scales. We also left column Z out of the national GPI for ease of comparison.

All monetary units were converted into year 2000 US dollars using the Northeast Region Consumer Price Index (CPI) from the U.S. Bureau of Labor Statistics (http://www.bls.gov/). Data from the national GPI were converted to year 2000 US dollars and included for comparison.

3. Summary of results

Tables 2–4 summarize our findings for all three spatial scales and for the time period from 1950 to 2000, with data every 10 years. Table 2 shows the primary results. The national data for the same time period are also included for comparison. (Note that the latest year for the national GPI is 1997, not 2000.) All lettered columns are in year 2000 US dollars, except column B, which is an index of income distribution. This 10-year time frequency was dictated by data limitations, with many data elements at the smaller scales coming from census data available only at 10 year intervals. We also list population time series for each scale and use it to calculate GPI per capita. Table 3 shows all columns (except B, which is an income distribution index) converted to per capita format by dividing by population at each scale. This makes it easier to compare all the columns across scales.

Table 4 shows the columns of Table 2 aggregated into seven of the eight functional groups shown above. We left off "net investment" since column Z was not included in the index and column Y turned out to be relatively unimportant.

Fig. 2 is a summary of the GPI per capita for all four spatial scales for the 1950–2000 time period. This allows the most direct comparison with the national figures. While national GPI per capita peaked in 1970–1980 and has continued downward to 1997, all three scales in Vermont have continued upward over the entire interval, although at decreasing rates in the last decade. While Burlington was initially well below the national average GPI per capita in 1950, with Chittenden County and the state as a whole slightly above it, by 2000 all three scales in Vermont were well above the national average GPI per capita. The national average GPI per capita in 2000 was about US$8000, while all three scales in Vermont were above US$16,000, more than double the national average.

Why has Vermont done so much better in recent years than the national average? Inspection of Tables 2 and 3 gives some clues. The positive side of the ledger (income and households) per capita are very similar to the national average. For example, Fig. 3 plots adjusted personal consumption per capita (column C) for all four scales and one can see very similar patterns of growth at all four scales. Fig. 4 plots household work and capital (columns D, E, F, L and N). Burlington stands out slightly in this plot, mainly due to the increased value of household labor per capita relative to the other scales.

The major differences with the national averages are in the pollution (columns P, Q, R), land loss (columns S, T and X) and natural capital (columns U, V and W) groups. Figs. 5–7 plot these groups of columns for all four scales. Note that the figures plot costs (negative numbers) increasing as one moves down the y-axis. Fig. 5 shows that the per capita costs of pollution for Burlington were much higher than the national average in the 1950–1970 period, but that since 1980 this has come down to approximately the national average. This explains

Table 2
GPI data by column for all four scales

	Year	Personal consumption	Income distribution	Adjusted personal consumption	Household work	Volunteer work	Household capital	Services of highways	Cost of crime	Cost of family breakdown
		A	B	C	D	E	F*	G	H	I
Burlington	1950	192,633,390	94	205,366,087	195,271,617	4,356,950	26,942,131	1,213,390	(1,942,825)	(1,517,265)
	1960	265,825,214	91	291,475,016	258,782,584	5,644,350	30,371,760	1,683,954	(2,131,765)	(3,998,029)
	1970	403,512,591	100	403,512,591	336,306,943	7,838,096	46,198,621	1,449,562	(2,788,361)	(5,932,321)
	1980	460,935,350	104	441,508,956	364,561,233	10,100,187	48,975,497	1,242,569	(4,043,168)	(8,541,811)
	1990	678,390,718	115	591,447,879	370,430,814	15,455,198	72,461,043	906,154	(4,018,398)	(8,419,077)
	2000	835,184,666	122	684,577,595	370,751,224	20,139,518	89,026,193	767,929	(4,428,987)	(8,459,000)
Chittenden	1950	464,042,968	92.2	503,300,399	349,302,557	7,957,799	64,902,073	12,275,627	(3,156,314)	(2,899,085)
County	1960	739,400,026	90.4	817,920,383	500,252,879	14,169,723	84,479,872	34,348,570	(3,639,784)	(9,227,069)
	1970	1,321,653,618	100.0	1,321,653,618	757,549,320	20,381,646	151,317,643	51,718,456	(5,523,657)	(16,009,398)
	1980	1,802,518,649	104.5	1,724,898,229	975,278,939	33,147,857	191,521,972	25,484,185	(10,181,508)	(29,309,009)
	1990	2,839,557,481	118.9	2,388,189,639	1,096,048,950	58,666,840	303,302,051	18,416,284	(10,767,972)	(33,605,145)
	2000	3,902,900,624	132.3	2,950,038,264	1,257,625,246	82,506,183	416,028,213	13,951,731	(11,671,292)	(37,901,359)
Vermont	1950	2,643,236,766	96.0	2,753,371,632	2,125,270,681	49,807,602	369,688,922	64,382,700	(14,573,287)	(17,798,929)
	1960	3,511,496,927	92.0	3,816,844,486	2,715,917,944	62,449,371	401,204,763	179,835,456	(16,573,818)	(50,934,313)
	1970	5,592,325,680	100.0	5,592,325,680	3,520,108,367	96,099,008	640,271,801	224,862,859	(24,624,252)	(76,036,619)
	1980	7,368,210,699	102.0	7,223,735,979	4,319,380,381	143,903,659	782,890,234	112,761,887	(45,146,086)	(136,324,899)
	1990	10,445,861,545	109.0	9,583,359,215	4,650,956,997	222,190,094	1,115,755,274	74,071,219	(47,679,212)	(150,912,894)
	2000	13,062,709,297	117.0	11,164,708,801	4,916,830,517	291,321,040	1,392,414,549	57,891,000	(50,138,476)	(166,026,908)
United	1950	1,271,943,000,000	108.0	1,178,094,000,000	743,658,000,000	26,937,000,000	75,276,000,000	36,654,000,000	(9,963,000,000)	(18,450,000,000)
States	1960	1,762,098,000,000	104.2	1,690,389,000,000	1,079,325,000,000	27,798,000,000	115,374,000,000	46,125,000,000	(13,776,000,000)	(32,841,000,000)
	1970	2,703,294,000,000	101.5	2,662,089,000,000	1,503,921,000,000	57,195,000,000	201,597,000,000	78,105,000,000	(19,680,000,000)	(49,692,000,000)
	1980	3,701,931,000,000	103.9	3,564,171,000,000	1,870,953,000,000	102,213,000,000	336,282,000,000	94,464,000,000	(29,397,000,000)	(64,944,000,000)
	1990	5,082,606,000,000	110.3	4,607,580,000,000	2,122,734,000,000	103,935,000,000	534,681,000,000	95,202,000,000	(35,178,000,000)	(67,404,000,000)
	1997	6,043,716,315,000	118.3	5,108,805,000,000	2,320,518,000,000	107,871,000,000	685,233,000,000	110,700,000,000	(34,932,000,000)	(72,324,000,000)

All values are in constant 2000 US dollars, except year, column B (distribution) and population. Column Z is not included in GPI for reasons explained in the text.

	Year	Loss of leisure time	Cost underemployment	Consumer durables	Cost of commuting	Pollution abatement	Cost of car accidents	Cost of water pollution	Cost of air pollution	Cost of noise pollution	Loss of wetlands
		J	K	L	M	N	O	P	Q	R	S
Burlington	1950	(9,875,232)	(3,356,366)	(30,791,006)	(8,304,354)	(2,629,019)	(27,405,591)	(87,666)	(130,646,540)	(5,005,080)	(51,600)
	1960	(6,046,061)	(4,759,072)	(34,710,583)	(11,456,246)	(2,813,391)	(9,340,000)	(126,349)	(105,001,487)	(4,146,790)	(57,600)
	1970	(725,481)	(8,436,186)	(52,798,424)	(17,849,684)	(5,356,606)	(58,635,236)	(171,338)	(96,464,265)	(3,578,928)	(72,600)
	1980	(14,463,491)	(22,341,524)	(55,971,997)	(25,072,705)	(5,534,535)	(42,030,000)	(193,539)	(30,130,973)	(3,300,486)	(94,600)
	1990	(43,808,672)	(31,148,526)	(82,812,620)	(28,928,443)	(6,203,403)	(31,354,800)	(193,539)	(23,903,660)	(3,058,145)	(159,600)
	2000	(108,676,864)	(27,072,740)	(101,744,221)	(41,782,758)	(6,230,329)	(24,177,150)	(158,769)	(13,056,529)	(2,956,249)	(237,600)
Chittenden County	1950	(18,636,823)	(6,334,122)	(74,173,797)	(10,434,350)	(5,820,133)	(51,719,736)	(322,653)	(107,978,502)	(6,435,427)	(2,661,000)
	1960	(12,664,150)	(9,968,589)	(96,548,426)	(18,061,109)	(6,844,677)	(83,885,342)	(465,024)	(94,560,363)	(6,016,353)	(3,048,000)
	1970	(1,861,531)	(21,646,973)	(172,934,449)	(34,769,462)	(9,952,898)	(150,456,075)	(630,605)	(102,486,960)	(5,902,842)	(3,678,000)
	1980	(29,994,783)	(49,038,255)	(218,882,254)	(62,691,145)	(12,760,164)	(126,090,000)	(712,313)	(34,617,413)	(6,697,592)	(4,704,000)
	1990	(105,188,602)	(67,062,493)	(346,630,916)	(113,210,659)	(15,144,507)	(116,750,000)	(712,313)	(56,485,081)	(6,789,947)	(6,375,000)
	2000	(329,289,482)	(77,252,017)	(475,460,815)	(182,932,447)	(16,209,098)	(88,983,254)	(584,344)	(50,470,608)	(8,025,409)	(6,840,000)
Vermont	1950	(69,181,821)	(23,500,113)	(422,501,625)	(39,184,063)	(26,915,877)	(312,890,000)	(1,294,537)	(496,299,377)	(20,773,914)	(45,669,000)
	1960	(44,007,952)	(34,629,748)	(458,519,729)	(67,752,328)	(27,818,924)	(476,340,000)	(1,865,751)	(448,790,838)	(17,497,141)	(51,526,000)
	1970	(5,699,962)	(66,301,009)	(731,739,201)	(129,409,675)	(37,529,675)	(579,080,000)	(2,530,092)	(489,864,865)	(13,959,802)	(63,117,000)
	1980	(119,633,165)	(184,811,771)	(894,731,696)	(226,976,264)	(50,148,670)	(555,730,000)	(2,857,916)	(190,966,834)	(15,117,454)	(80,726,000)
	1990	(352,837,911)	(256,318,729)	(1,275,148,884)	(383,651,699)	(66,579,951)	(495,020,000)	(2,857,916)	(366,131,375)	(14,158,508)	(106,491,000)
	2000	(922,093,018)	(261,127,272)	(1,591,330,913)	(651,950,349)	(57,634,245)	(368,930,000)	(2,344,486)	(273,114,888)	(17,677,898)	(114,668,000)
United States	1950	(12,423,000,000)	(16,359,000,000)	(104,304,000,000)	(141,696,000,000)	(738,000,000)	(29,151,000,000)	(26,076,000,000)	(79,704,000,000)	(7,503,000,000)	(54,858,000,000)
	1960	(6,519,000,000)	(31,857,000,000)	(129,273,000,000)	(160,884,000,000)	(861,000,000)	(36,285,000,000)	(42,066,000,000)	(88,068,000,000)	(10,209,000,000)	(73,062,000,000)
	1970	(2,829,000,000)	(61,623,000,000)	(230,133,000,000)	(205,656,000,000)	(4,428,000,000)	(74,169,000,000)	(54,120,000,000)	(110,700,000,000)	(13,899,000,000)	(114,390,000,000)
	1980	(150,921,000,000)	(114,759,000,000)	(347,598,000,000)	(291,387,000,000)	(10,209,000,000)	(102,951,000,000)	(61,623,000,000)	(90,282,000,000)	(15,990,000,000)	(193,110,000,000)
	1990	(227,058,000,000)	(203,811,000,000)	(606,759,000,000)	(393,231,000,000)	(11,931,000,000)	(125,706,000,000)	(61,623,000,000)	(71,463,000,000)	(17,589,000,000)	(315,495,000,000)
	1997	(324,228,000,000)	(150,429,000,000)	(822,378,000,000)	(460,635,000,000)	(13,653,000,000)	(148,215,000,000)	(61,623,000,000)	(66,666,000,000)	(18,819,000,000)	(430,377,000,000)

(continued on next page)

Table 2 (*continued*)

	Year	Non renewable resources	Long-term env. damage	Ozone depletion	Loss of forest	Net investment	Net borrowing/ lending	GPI	Population	GPI/capita
		U	V	W	X	Y	Z			
Burlington	1950	(39,758,362)	(47,306,652)	(142,485)	(350,000)	2,241,000	(112,347,814)	126,192,131	33,155	3806
	1960	(93,797,204)	(56,348,867)	(661,184)	(375,000)	7,698,000	(182,087,342)	259,772,035	35,531	7311
	1970	(157,136,693)	(55,250,103)	(7,040,378)	(416,000)	16,856,000	(252,768,605)	339,203,210	38,633	8780
	1980	(158,108,737)	(54,385,985)	(13,582,148)	(483,000)	8,251,001	(185,706,669)	436,002,745	37,712	11,561
	1990	(132,268,022)	(50,631,577)	(14,746,413)	(526,000)	11,074,001	(273,708,618)	599,151,193	39,127	15,313
	2000	(127,096,516)	(53,395,856)	(14,836,766)	(745,000)	7,854,000	(290,990,869)	637,586,124	39,824	16,010
Chittenden	1950	(89,853,381)	(106,912,419)	(322,015)	(12,096,000)	4,230,000	(9,879,078)	441,877,697	62,570	7062
County	1960	(210,552,162)	(126,489,652)	(1,486,369)	(10,501,000)	16,124,001	(186,885,216)	772,692,360	77,425	9980
	1970	(438,409,207)	(154,147,026)	(19,284,233)	(8,147,000)	43,252,001	(402,540,069)	1,197,527,367	99,131	12,080
	1980	(487,260,791)	(163,133,952)	(38,906,654)	(4,632,000)	28,182,000	(544,551,587)	1,694,129,348	115,534	14,663
	1990	(477,275,321)	(176,900,383)	(42,974,451)	(5,277,000)	37,294,000	(862,300,334)	2,312,918,977	131,761	17,554
	2000	(506,667,486)	(205,839,949)	(43,310,648)	(10,134,000)	28,244,001	(1,070,982,891)	2,687,899,428	146,571	18,339
Vermont	1950	(542,461,966)	(645,450,624)	(1,944,067)	(90,813,000)	25,538,000	(792,892,712)	2,615,125,336	377,747	6923
	1960	(1,102,993,448)	(662,625,624)	(8,043,620)	(60,042,000)	84,470,001	(1,096,099,706)	3,722,606,787	389,881	9548
	1970	(1,965,060,000)	(690,925,624)	(87,818,112)	(19,263,000)	193,868,001	(1,821,543,814)	5,266,753,827	444,732	11,843
	1980	(2,157,048,621)	(722,175,624)	(174,684,358)	1,976,000	111,909,000	(2,660,816,137)	7,109,345,782	511,456	13,900
	1990	(2,038,467,414)	(755,550,624)	(192,058,129)	20,268,000	159,285,000	(4,228,360,061)	9,281,155,553	562,758	16,492
	2000	(1,961,295,517)	(796,800,624)	(193,454,625)	51,609,000	118,187,000	(5,251,081,074)	10,518,897,688	588,067	17,887
United	1950	(189,051,000,000)	(300,981,000,000)	(4,059,000,000)	(54,120,000,000)	10,332,000,000	0	995,562,000,000	152,272,813	6538
States	1960	(313,896,000,000)	(420,783,000,000)	(20,910,000,000)	(55,596,000,000)	39,237,000,000	1,476,000,000	1,510,809,000,000	180,666,588	8362
	1970	(634,434,000,000)	(589,539,000,000)	(85,116,000,000)	(60,639,000,000)	89,544,000,000	(3,813,000,000)	2,203,668,000,000	205,052,057	10,747
	1980	(893,964,000,000)	(817,704,000,000)	(217,710,000,000)	(70,971,000,000)	50,061,000,000	2,829,000,000	2,437,614,000,000	227,236,285	10,727
	1990	(1,267,761,000,000)	(1,052,142,000,000)	(345,015,000,000)	(95,940,000,000)	71,094,000,000	(73,554,000,000)	2,500,836,000,000	249,437,464	10,026
	1997	(1,576,368,000,000)	(1,244,760,000,000)	(377,487,000,000)	(101,106,000,000)	54,489,000,000	(179,703,000,000)	2,326,422,000,000	267,638,895	8692

Burlington's lower GPI per capita in 1950 than the other three scales. Fig. 6 shows the land loss (columns S, T and X) group, showing all three Vermont scales with significantly lower costs per capita than the national average. This is due in part to the regrowth of northeastern forests as farming and timber production moved westward, and more recently to Vermont's strict planning and zoning regulations that protect farmlands, forests and wetlands. Vermont's relatively low rates of population growth and population density relative to the national average also contribute to reduced pressure on the environment. Vermont's land area is 24,900 km^2 with a population in the year 2000 of 588,067. This is slightly larger than New Jersey in area (at 20,160 km^2) with less than 10% of New Jersey's population of more than 7 million. Vermont is slightly smaller in area than Belgium at 30,500 km^2. Vermont has about 24 people/km^2. New Jersey has about 370 people/km^2 and Belgium has about 330 people/km^2 for comparison. Alaska has about 0.3 people/km^2 and the average for the lower 48 States is about 35 people/km^2.

Fig. 7 shows the natural capital depletion (columns U, V and W) group. This group shows the largest difference between the three Vermont scales and the national average, with Vermont having more than US$6000 per capita less natural capital depletion than the US average. This is due to Vermont's shift away from fossil energy sources to hydro (from Hydo Quebec and other smaller scale local sources) and biomass (e.g. the McNeill wood-burning power plant in Burlington), as well as a focus on energy conservation at all three Vermont scales.

4. Limitations

There are, of course, numerous sources of error and uncertainty in estimating the GPI at the national scale, which are only compounded at the three smaller scales. These include:

- There are several assumptions built into the GPI that are open to question (Neumayer, 2000; Lawn, 2003). For example, when valuing household or volunteer work, one has to decide on a wage rate. The GPI assumes the "going rate" for household workers or volunteers performing the same tasks as paid workers. But this could be well below or well above the "real" rate, because, for example, paid household workers may be significantly underpaid or volunteers may be significantly less skilled than paid workers doing the same jobs. While one could argue about these points indefinitely, our approach here was (to the extent possible) to use the same assumptions made in estimating the National GPI so that the comparison between the two (which was a major motivation for this work) would be as easy to interpret as possible. This does not imply that these are necessarily the right assumptions, but for our purposes it made the most sense to take this approach.
- Data availability for the elements of the GPI generally decreased with decreasing scale. Data at the state level was relatively available for the GPI elements, but at the county and especially city scales it got significantly more difficult. In lieu of local data, some of the columns were based on national or state figures scaled down to the local level using ratios of various kinds. This method obviously does not fully capture the unique qualities present at the smaller scales. We included these scaled values for completeness, so that their omission would not skew the final GPI estimates one way or the other, but it also prevents us from seeing some potentially important differences. We identified several columns where additional work would probably yield better numbers. Our goal in the present study was to achieve a "first cut" and use these results to decide where to put additional effort. The most significant improvements could be made by addressing those columns, which both proved to be significant contributors to the GPI at our scales and for which additional effort would probably yield better numbers. Given this, we determined that assembling better data on the following would be the most helpful:
    1. Personal consumption expenditures. Only data on personal income was available at the county and city scales, and we had to estimate personal consumption as a fraction of income using national averages. Survey methods could address this issue.
    2. Household work. This is a significant contributor to GPI but we had no direct

Table 3
GPI per capita data by column for all four scales

	Year	Personal consumption per capita	Distribution	Adjusted consumption per capita	Household work per capita	Volunteer work per capita	Household capital per capita	Services of highways per capita	Cost of crime per capita	Family breakdown per capita	Loss of leisure time per capita	Cost of underemployment per capita	Cost of consumer durables per capita	Cost of commuting per capita	Cost of pollution abatement per capita
		A	B	C	D	E	F*	G	H	I	J	K	L	M	N
Burlington	1950	5810	93.8	6194	5890	131	813	37	(59)	(46)	(298)	(101)	(929)	(250)	(79)
	1960	7482	91.2	8203	7283	159	855	47	(60)	(113)	(170)	(134)	(977)	(322)	(79)
	1970	10,445	100.0	10,445	8705	203	1196	38	(72)	(154)	(19)	(218)	(1367)	(462)	(139)
	1980	12,223	104.4	11,707	9667	268	1299	33	(107)	(227)	(384)	(592)	(1484)	(665)	(147)
	1990	17,338	114.7	15,116	9467	395	1852	23	(103)	(215)	(1120)	(796)	(2117)	(739)	(159)
	2000	20,972	122.0	17,190	9310	506	2235	19	(111)	(212)	(2729)	(680)	(2555)	(1049)	(156)
Chittenden	1950	7416	92.2	8044	5583	127	1037	196	(50)	(46)	(298)	(101)	(1185)	(167)	(93)
County	1960	9550	90.4	10,564	6461	183	1091	444	(47)	(119)	(164)	(129)	(1247)	(233)	(88)
	1970	13,332	100.0	13,332	7642	206	1526	522	(56)	(161)	(19)	(218)	(1745)	(351)	(100)
	1980	15,602	104.5	14,930	8441	287	1658	221	(88)	(254)	(260)	(424)	(1895)	(543)	(110)
	1990	21,551	118.9	18,125	8318	445	2302	140	(82)	(255)	(798)	(509)	(2631)	(859)	(115)
	2000	26,628	132.3	20,127	8580	563	2838	95	(80)	(259)	(2247)	(527)	(3244)	(1248)	(111)
Vermont	1950	6997	96.0	7289	5626	132	979	170	(39)	(47)	(183)	(62)	(1118)	(104)	(71)
	1960	9007	92.0	9790	6966	160	1029	461	(43)	(131)	(113)	(89)	(1176)	(174)	(71)
	1970	12,575	100.0	12,575	7915	216	1440	506	(55)	(171)	(13)	(149)	(1645)	(291)	(84)
	1980	14,406	102.0	14,124	8445	281	1531	220	(88)	(267)	(234)	(361)	(1749)	(444)	(98)
	1990	18,562	109.0	17,029	8265	395	1983	132	(85)	(268)	(627)	(455)	(2266)	(682)	(118)
	2000	22,213	117.0	18,985	8361	495	2368	98	(85)	(282)	(1568)	(444)	(2706)	(1109)	(98)
United	1950	8353	108.0	7737	4884	177	494	241	(65)	(121)	(82)	(107)	(685)	(931)	(5)
States	1960	9753	104.2	9356	5974	154	639	255	(76)	(182)	(36)	(176)	(716)	(891)	(5)
	1970	13,183	101.5	12,983	7334	279	983	381	(96)	(242)	(14)	(301)	(1122)	(1003)	(22)
	1980	16,291	103.9	15,685	8234	450	1480	416	(129)	(286)	(664)	(505)	(1530)	(1282)	(45)
	1990	20,376	110.3	18,472	8510	417	2144	382	(141)	(270)	(910)	(817)	(2433)	(1576)	(48)
	1997	22,582	118.3	19,088	8670	403	2560	414	(131)	(270)	(1211)	(562)	(3073)	(1721)	(51)

All values are in constant US$2000 except year, column B (distribution) and population. Column Z is not included since it was not included in GPI for reasons explained in the text.

Table 3 (*continued*)

	Year	Cost of car accidents per capita	Cost of water pollution per capita	Cost of air pollution per capita	Cost of noise pollution per capita	Loss of wetlands per capita	Loss of farmlands per capita	Non renewable resources per capita	Long-term env. damage per capita	Ozone depletion per capita	Loss of forest per capita	Net investment per capita	GPI per capita	Population
		O	P	Q	R	S	T	U	V	W	X	Y		
Burlington	1950	(827)	(3)	(3940)	(151)	(2)	(1)	(1199)	(1427)	(4)	(11)	68	3806	33,155
	1960	(263)	(4)	(2955)	(117)	(2)	(3)	(2640)	(1586)	(19)	(11)	217	7311	35,531
	1970	(1518)	(4)	(2497)	(93)	(2)	(8)	(4067)	(1430)	(182)	(11)	436	8780	38,633
	1980	(1114)	(5)	(799)	(88)	(3)	(9)	(4193)	(1442)	(360)	(13)	219	11,561	37,712
	1990	(801)	(5)	(611)	(78)	(4)	(11)	(3380)	(1294)	(377)	(13)	283	15,313	39,127
	2000	(607)	(4)	(328)	(74)	(6)	(12)	(3191)	(1341)	(373)	(19)	197	16,010	39,824
Chittenden County	1950	(827)	(5)	(1726)	(103)	(43)	(5)	(1436)	(1709)	(5)	(193)	68	7062	62,570
	1960	(1083)	(6)	(1221)	(78)	(39)	(8)	(2719)	(1634)	(19)	(136)	208	9980	77,425
	1970	(1518)	(6)	(1034)	(60)	(37)	(25)	(4423)	(1555)	(195)	(82)	436	12,080	99,131
	1980	(1091)	(6)	(300)	(58)	(41)	(41)	(4217)	(1412)	(337)	(40)	244	14,663	115,534
	1990	(886)	(5)	(429)	(52)	(48)	(60)	(3622)	(1343)	(326)	(40)	283	17,554	131,761
	2000	(607)	(4)	(344)	(55)	(47)	(61)	(3457)	(1404)	(295)	(69)	193	18,339	146,571
Vermont	1950	(828)	(3)	(1314)	(55)	(121)	(4)	(1436)	(1709)	(5)	(240)	68	6923	377,747
	1960	(1222)	(5)	(1151)	(45)	(132)	(21)	(2829)	(1700)	(21)	(154)	217	9548	389,881
	1970	(1302)	(6)	(1101)	(31)	(142)	(40)	(4419)	(1554)	(197)	(43)	436	11,843	444,732
	1980	(1087)	(6)	(373)	(30)	(158)	(59)	(4217)	(1412)	(342)	4	219	13,900	511,456
	1990	(880)	(5)	(651)	(25)	(189)	(73)	(3622)	(1343)	(341)	36	283	16,492	562,758
	2000	(627)	(4)	(464)	(30)	(195)	(77)	(3335)	(1355)	(329)	88	201	17,887	588,067
United States	1950	(191)	(171)	(523)	(49)	(360)	(170)	(1242)	(1977)	(27)	(355)	68	6538	152,272,813
	1960	(201)	(233)	(487)	(57)	(404)	(280)	(1737)	(2329)	(116)	(308)	217	8362	180,666,588
	1970	(362)	(264)	(540)	(68)	(558)	(379)	(3094)	(2875)	(415)	(296)	437	10,747	205,052,057
	1980	(453)	(271)	(397)	(70)	(850)	(471)	(3934)	(3598)	(958)	(312)	220	10,727	227,236,285
	1990	(504)	(247)	(286)	(71)	(1,265)	(546)	(5082)	(4218)	(1,383)	(385)	285	10,026	249,437,464
	1997	(554)	(230)	(249)	(70)	(1,608)	(587)	(5890)	(4651)	(1,410)	(378)	204	8692	267,638,895

Table 4
Summary indicators

	Year	Income	Households	Loss of mobility	Loss of social capital	Pollution	Land loss	Natural capital depl.
		A, B, C	D, E, F, L, N	G, M, O	H, I, J, K	P, Q, R	S, T, X	U, V, W
Burlington	1950	6194	5826	(1040)	(503)	(4094)	(13)	(2630)
	1960	8203	7241	(538)	(477)	(3075)	(15)	(4244)
	1970	10,445	8599	(1942)	(463)	(2594)	(21)	(5680)
	1980	11,707	9603	(1746)	(1310)	(892)	(25)	(5995)
	1990	15,116	9439	(1518)	(2234)	(694)	(29)	(5051)
	2000	17,190	9340	(1637)	(3732)	(406)	(37)	(4905)
Chittenden County	1950	8044	5469	(797)	(496)	(1834)	(241)	(3150)
	1960	10,564	6400	(873)	(459)	(1305)	(183)	(4372)
	1970	13,332	7529	(1347)	(454)	(1100)	(145)	(6172)
	1980	14,930	8381	(1413)	(1026)	(364)	(122)	(5966)
	1990	18,125	8320	(1606)	(1644)	(486)	(148)	(5291)
	2000	20,127	8627	(1760)	(3112)	(403)	(177)	(5157)
Vermont	1950	7289	5547	(762)	(331)	(1372)	(366)	(3150)
	1960	9790	6908	(934)	(375)	(1201)	(307)	(4549)
	1970	12,575	7841	(1087)	(388)	(1139)	(225)	(6170)
	1980	14,124	8410	(1310)	(950)	(409)	(213)	(5971)
	1990	17,029	8258	(1430)	(1435)	(681)	(226)	(5306)
	2000	18,985	8420	(1638)	(2380)	(498)	(185)	(5019)
United States	1950	7737	4865	(881)	(376)	(744)	(886)	(3245)
	1960	9356	6046	(836)	(470)	(777)	(992)	(4182)
	1970	12,983	7453	(984)	(653)	(872)	(1233)	(6384)
	1980	15,685	8589	(1320)	(1584)	(739)	(1633)	(8491)
	1990	18,472	8590	(1699)	(2139)	(604)	(2196)	(10,684)
	1997	19,088	8510	(1861)	(2174)	(550)	(2573)	(11,951)

estimates of the hours of household work performed for our study areas. Survey methods could address this issue.

3. Leisure time: As in 2, no direct estimates of leisure time were available for our study areas. Survey methods could likewise address this issue.
4. Household capital and consumer durables. As in 1 (above), no direct estimates of consumer durables were available for our

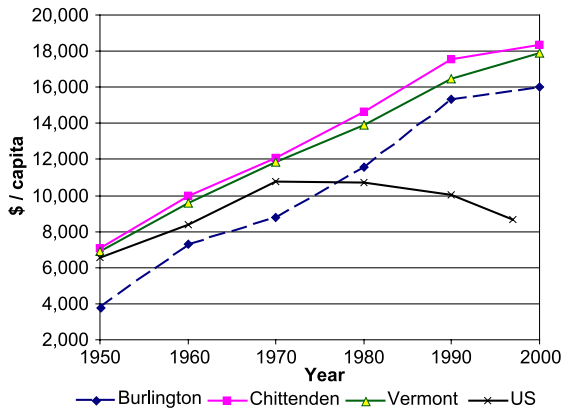

Fig. 2. GPI per capita for Burlington, VT, Chittenden County, VT, the State of Vermont and the United States, 1950–2000.

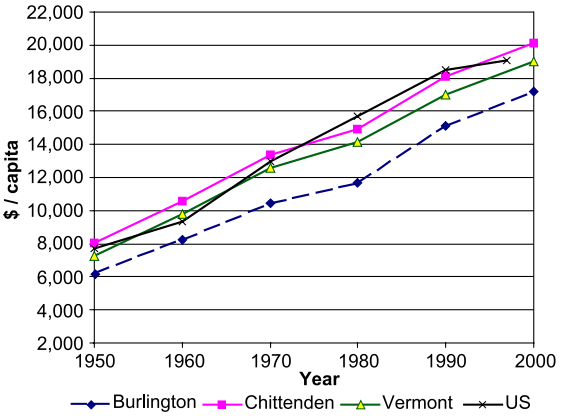

Fig. 3. Personal consumption per capita adjusted for income distribution (column C).

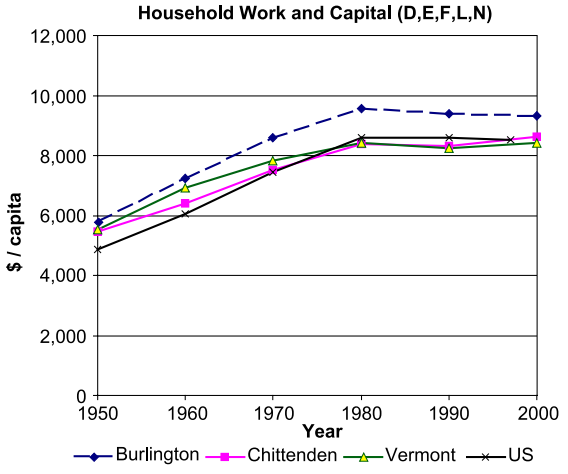

Fig. 4. Household work and capital per capita (columns D, E, F, L and N).

study areas. Survey methods could likewise address this issue.

5. Costs of commuting. Another case where no direct data was available and surveys would be needed to generate it.
6. Loss of wetlands, farmlands, non-renewable resources and long-term environmental damage. Data on the actual loss of land and resources are fairly available, but the limiting factor here is estimating the value of the lost ecosystem services. Research is ongoing on this issue and can be incorporated as the estimates improve.
7. Net foreign borrowing/lending. We need to find a way to either estimate "foreign lending" at the scales we are addressing or drop this term from the index (as we did for our present analysis).

- Interregional flows of non-marketed goods and services (i.e. ecosystem services) are not captured in either GDP or GPI. For example, while Vermont may be benefiting from a better local environment, this may be at least partly at the expense of a depleted environment elsewhere in the country or the world. This effect is not addressed. However, the same effect is also a factor at the national scale. The U.S. is certainly benefiting at the expense of

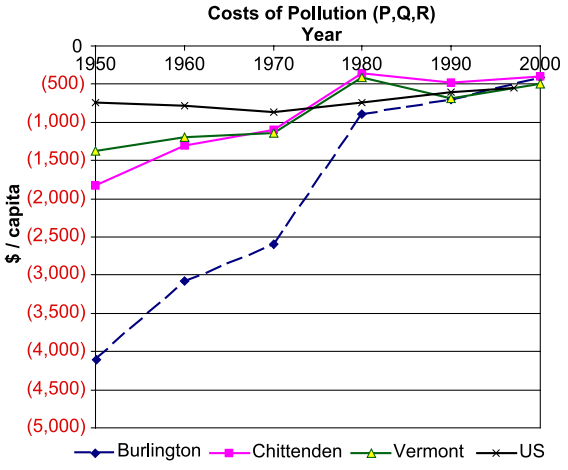

Fig. 5. Costs of pollution per capita (columns P, Q and R).

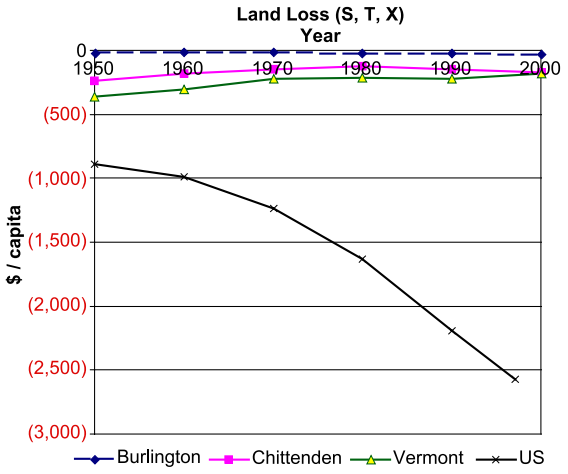

Fig. 6. Costs of land loss per capita (columns S, T and X).

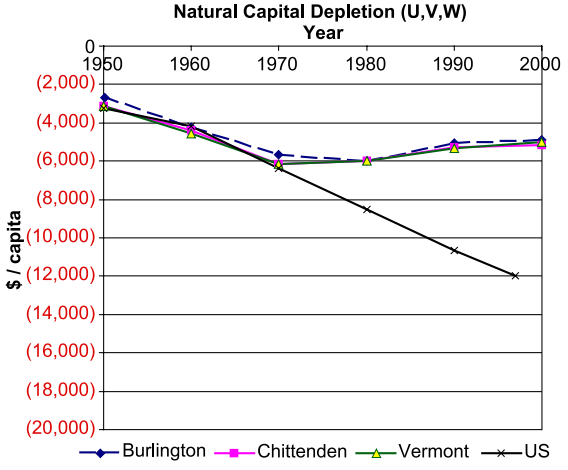

Fig. 7. Costs of natural capital depletion (columns U, V and W).

depletion of natural capital located elsewhere in the world. The question for explaining the differences between Vermont and the U.S. is whether this effect is significantly larger for Vermont than for the U.S. as a whole. While incorporating some measure of these transboundary effects would improve GPI in general, it seems highly unlikely that this effect would explain very much of the differences between the Vermont and the U.S. GPI's.

In spite of these limitations, we feel that our initial efforts have yielded an interesting picture of the GPI at scales for which it has not before been estimated. The exercise has also alerted us to the major data limitations at these scales and we have begun to think about how to improve both the data and the index itself.

5. Conclusions

1. The GPI is a significantly different and more comprehensive approach to assessing economic progress than conventional measures like GDP. While it is far from perfect, it is a better approximation to economic welfare than GDP, because it accounts for income distribution effects, the value of household and volunteer work, costs of mobility and pollution, and the depletion of social and natural capital (Costanza et al., 2001).
2. This was the first attempt to estimate GPI at multiple scales (the city, county and state levels). We have shown that it is feasible to apply the GPI approach at these scales and to compare across scales and with the national average. Data limitations and problems still exist, but potential solutions to these problems also exist.
3. All three Vermont scales have had significantly higher GPI per capita since 1980 than the national average. The GPI per capita for all Vermont scales was twice the national average in 2000. This indicates a significantly higher sustainable economic welfare for Vermont residents. The main factors explaining this difference had to do with Vermont's much better environmental performance than the national average.
4. Continued emphasis on the environment in Vermont will help the state maintain its lead in sustainable economic welfare per capita. It can enhance welfare even further by improving income and its distribution, social capital and personal mobility, but in a balanced way that does not sacrifice gains in the other factors or in environmental performance.
5. Future work will focus on: (1) improving the database for GPI at the city, county and state scale, including estimates of between-census years starting with the 1990s; (2) systemizing the calculations so that GPI can more easily be applied to other cities, counties and states across the country to allow comparisons at these scales; (3) devising improved indicators based on our experience with GPI at the city, county and state scales that recognize it's limitations at these scales and include the elements still missing from GPI; and (4) comparison of GPI and revised indicators with survey data to help understand how monetary-based indicators like GPI relate to people's subjective rankings of quality of life.

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