Calculating Cultural Ecosystem Services as Part of Greenspace Management?

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Abstract

Lake related greenspace provides many benefits to residents and visitors, which are often under-valued. The *Millennium Ecosystem Assessment* Project (2005) proposed the valuation of ecosystem services, defined as regulatory, provisional, ecosystem support and cultural services provided for us by nature, free of charge. The challenge here is: How can we use cultural ecosystem services derived from scenic landscapes for greenspace management and assessment?

Cultural ecosystem services received international recognition as part of the Millennium Ecosystem Assessment Project (2005). Also, as part of ecosystems services, are regulatory, provisional and ecosystem support. For this paper we are particularly concerned with *cultural services,* which include recreation, science and education, spiritual/historic as well as aesthetic functions. De Groot et al (2002) and Farber et al (2006) offer a progression of description of cultural Ecosystem services. De Groot et al (2002) describes *Information functions* as including; aesthetic information, recreation, cultural artistic information and spiritual/historic information. Farber et al (2005) for *cultural services* include; aesthetic, recreation, science/education, and spiritual/historic functions.

This paper presents ecosystem cultural services related to water based scenic landscape resources and then applies it to an Upstate New York lake landscape. A very careful accounting of greenspace ecosystem services is presented as they are applied to lakeshore residents, village residents and town/watershed residents and lake greenspace users utilizing user benefit calculations to yield over 10.6 million dollars of benefits per year (Smardon 2018).

Introduction, Background, Literature, Study Goals & Objectives

Cazenovia Lake provides multiple economic and non-economic benefits to the greater Cazenovia community. A study conducted in 2017 was designed to quantify those benefits, to the extent possible, in monetary values. Additionally, that study sought to determine how the community currently valued the lake. Driving this study was concern for the health of the lake within the community, and the need to better understand the impact of a healthy lake on the local economy. In the context of greenspace value assessment – such studies can improve the methodology for assessing values of such resources to the community at large.

Much of the literature supporting the ecosystem service methodology is within a previously published paper by Smardon (2018). This includes background on the measurement of ecosystem services plus assessment methods for water recreation, waterfront property values, water aesthetic values, and water quality improvement. All these methods are important for assessing values streams of waterfront greenspace.

Methods

Methods utilized for the assessment of values derived from Cazenovia Lake included:
1. Identification of direct and indirect benefit revenue streams;
2. Identification of appropriate valuation methods for each stream, or entity within a stream;
   a. Data gathering and analysis for all identified streams;
   b. Data collection and analysis for businesses, clubs, events plus outreach by phone and email;
   c. Data collection for water based recreational activities plus outreach and research;
3. GIS property tax assessment data collection & real estate sales comparisons by;
   a. Comparison of community to Non Lakefront community to establish lake benefit for property values;
   b. Comparison of properties within Cazenovia Township to determine lake influence and tax benefits; and
   c. Comparison of tax rates with other local municipalities.
4. Public Survey design and execution to determine community attitudes, participation and values concerning lake.

1. Identification of Direct and Indirect Benefit Revenue Streams

The first step in this process was to identify all the direct and indirect benefit revenue streams influencing the community that could be associated with the presence of the lake. The following lake related benefit matrix utilized the US EPA *Final Ecosystem Goods and Services Classification System* (Landers and Nahilk 2013) for the general classification of activities. The classification of recreation related activities and related benefits utilized the US Department of Interior Bureau of Reclamation *Water and Land Recreation Opportunity Spectrum* (WALROS) system (USDI, BR 2011). This is to represent the kinds of activities that benefit from either direct lake presence or visual proximity to the lake. They also may benefit from being within the lake watershed. These lake benefits are meant to give a holistic view of lake benefits to those adjacent to the lake, those who live within the lake watershed as well as visitors and other lake watershed users that receive these benefits year in and year out.

Overview of Cazenovia Lake Benefit streams

The following outlines the benefit flows to the Greater Cazenovia township/watershed area from Lake Cazenovia. Some of these benefit flows, like resource-dependent businesses and recreational activities, have quantifiable economic benefits. Some such as inspirational, learning activities and what we call *ecosystem services* are more difficult to quantify or translate to economic benefits. Let us start with the more direct economic benefit streams and move to the more indirect or less quantifiable.

- *Resource dependent businesses* are activities such as lakeside marinas, restaurants and agri-tourism facilities that are located on or near the lake that draw users because of location and/or views. Economic indicators are sales and expenditures from consumers who come because of the lakeside location, lakefront community identity and /or views.
- *Recreational activities* are a benefit stream because of physical and sensory lake access and may have a seasonal aspect.

- *Lake edge cultural activities* do not need lake physical access but are a draw because of visual proximity to the lake. Both sets of these activities can be quantified by on site expenditures and/or travel cost.
- *Inspirational activities* are special events that occur near the lake edge and/or have visual access to the lake such as weddings or other celebratory events. On site expenditures and/or travel costs can be used to quantify this benefit flow.
- *Learning or educational activities* are similar to inspirational activities and so are place connected to the historical heritage of Cazenovia Lake. The major draw in this regard is the *Lorenzo State Park*, but there are other cultural, historical and ecological attributes connected to the lake. Travel cost of visitors can be used to calculate benefit flows.

Activity category	Setting	Beneficiary experience	Benefit	Economic indicator
Resource-dependent business				
Marina	Lakeside presence	Water access	Water access	Sales +
Restaurant	Lakeside presence	Water views	View access	Expenditures
Agritourism	Lakeside presence	Water views	View access	Sales +
Recreational activities				
Motor boating	Dock/launch	Water experience	Water experience	Expenditures
Personal water craft	Launch point	Water experience	Water experience	Expenditures
Sailing	Launch point	Water experience	Multi-sensory	Rental cost
Paddleboard	Lake access	Water experience	Multi-sensory	Travel cost
Kayak/canoe	Lake access	Water experience	Multi-sensory	Travel cost
Swimming	Beach access	Water experience	Multi-sensory	Travel cost
Fishing/ice fishing	Water access	Water/ice experience	Multi-sensory	Expenditures
Wildlife viewing	Lake access	Viewing wildlife	Multi-sensory	Travel cost
Lake edge cultural activities				
Picnicking	Lake edge parks	Water views	Relaxation	Travel cost
Tennis/volleyball	Lake edge location	Water edge views	Relaxation	Rental cost
Foot races	Lake edge course	Water edge views	Relaxation	Travel cost
Bicycling/touring	Lake edge roads	Water edge views	Relaxation	Travel cost
Festivals	Lake edge location	Water edge views	Relaxation	Travel cost+
Inspirational activities				
Weddings + other events	Lake edge location	Water edge views	Presence	Event cost
Art related activity	Lake edge location	Aesthetic inspiration	Inspiration	Travel cost
Learning activities				
Historic interpretation	Lorenzo State Park	Historic understanding	Historic experience	Travel cost
Educational trips	Lake location	Educational understanding	Educational experience	Travel cost
Research	Lake location	Research opportunities	Educational experience	Travel cost
Municipal operations/revenue				
Residential owners	Lakeside	Lake environment	Lake access	Property value
Ecosystem services—regulatory				
Maintain water quality		Water related activities above		Water quality treatment
Nutrient retention		Downstream water quality		Water quality treatment
Sediment retention		Downstream water quality		Water quality treatment
Carbon storage		Reduced CO_2		Climate change mitigation
Ecosystem services—production				
Water supply	Lakeside residences	Drinking water		Replacement cost
	Erie Canal (historic)	Water level		Replacement cost
Ecosystem services—support				
Aquatic habitat		Fish and wildlife		Enhancement
Food chain		Sustain fish and wildlife		Enhancement
Ecosystem services—cultural				
See recreational-cultural-inspirational-educational activities above plus				
Public views of the lake		aesthetic enjoyment		Viewer numbers
Existence value		Knowledge of existence		Option value

Fig. 1: Cazenovia Lake value stream classification and methods.
Source; Smardon 2018 p. 64

Lakeside Property Values: One of the major benefit flows includes amenities of being on the lake by lakeside property owners**.** The literature (Smardon 2018) supports increased property values because of physical proximity and water view access. This translates to higher assessed value for these lakeside properties and higher real estate tax revenue for the Village and Town of Cazenovia.

Ecosystem Services: Another benefit flow array is what we call *ecosystem services*. Such can be defined as those natural functions from the lake that benefit us but nature provides for no economic cost. Ecosystem services can be divided up into *regulatory* (improving water quality), *provisional* (providing drinking water), *ecosystem support* (habitat for fish and wildlife) and *cultural* (aesthetic, education and recreation benefits).

2. Identifying appropriate valuation methods for each revenue stream

The second step was to identify appropriate methods for each benefit revenue stream (see Smardon & Gavitt 2017). For each category of benefit revenue stream, and often for each subcategory or specific entity within a revenue stream, unique methods were needed to determine the value generated that can be associated with the presence of a healthy lake. This led us to design a multi-prong approach to gathering data and designing specific formulas for applying the data to determine valuation relevant to each contributing business, event, activity, or overall revenue stream (see Figure 1).

Detailed quantification methods used for each revenue stream were developed for:
- Resource dependent businesses, marinas, restaurants and agri-tourism activity;
- Recreational activity including; motor boating, personal water craft, sailing, paddle boarding, kayak, canoe, swimming, fishing, ice fishing and wildlife viewing;
- Lake edge activities such as picnicking, tennis/volleyball, bicycling/touring, festivals and day camps;
- Inspirational activities such as weddings, events and art related activity; and
- Learning activities such as historic interpretation, educational trips, and lake related research.

Lakeside Property Values:
Comparison of community tax assessments and real estate values to a comparable non-lakefront community to establish the presence of a lake influence factor on real estate values. Use of *hedonic method* for analysis of local properties influenced by the lake. The ultimate goal was to establish a quantity of tax contribution from lakefront and lake influenced properties associated with the positive valuation of the lake. GIS tax data from 2015 was utilized and confirmed by recent real estate sales comparisons.

Ecosystem Services such as regulatory, production, support and cultural are calculated as an entire lake watershed system at $85/per household based on meta-analysis by Campbell et al (undated) which was in international survey of ecosystem lake benefits or functions.

Water supply: This was a calculation of approximately 30 homes currently using lake water for home use with $10K cost of water supply replacement wells.

2a. Data Collection and Analysis

Based on the analysis of direct and indirect benefit revenue streams, the authors made every effort to identify the businesses, parks, activities and clubs that fell into the previously identified categories of revenue streams. Targeted outreach was conducted to identify the quantities of participants, service, etc.

from each entity. Detailed spreadsheets were constructed to tabulate data as it was collected. The methods of outreach included direct phone calls and emails. Entities such as the local municipality, chamber of commerce, local restaurants, state historic sites, clubs, hotels, etc. were asked specific questions pertaining to the amount of users they had on an annual basis and, where possible, estimates as to how much those users were spending. This data collection could not have been done without the assistance of a person very familiar with the workings of the local community. It is also important to note that privacy of information was guaranteed for all entities sharing information with us.

2b. Data Collection for Businesses, Clubs and Organized events

Direct and indirect revenue generation was calculated from lake dependent businesses such as water recreation, lake view restaurants, breweries, wineries, and lake dependent tourism (historic, cultural, agri-tourism). This included quantification of revenue from businesses such as boat rentals, restaurants, inns, as well as recreational based clubs. Lake dependent or lake influenced activities such as races, concerts, special events and weddings were itemized. Each entity was contacted with specific questions for data that would assist us in quantifying the associated revenue streams. It was important to gain a complete understanding of each entity and to figure out all the ways in which it was contributing to the economy. Very specific information was collected regarding fees, quantity of users, frequency of events, and distance patrons were traveling.

Then, based on the type of business, club, activity or event, we determined an appropriate formula for valuation. For instance, restaurants were asked how many meals they served per year, and those numbers were multiplied by the average cost per meal. Additionally, estimates were made on the proportion of out-of-town patrons served, and travel costs were applied proportionately. Those expenditures were then multiplied by a *lake influence percentage factor*. For instance, a restaurant on the lake would have a greater percentage of its revenue associated with the lake than a restaurant nestled within the lakefront community, but not located directly on the lakefront.

For the purposes of this survey, privacy was ensured in return for fiscal data. Many entities reported very specific data, while others chose not to disclose revenue. In cases where data was not shared, we made an effort to conservatively compare with like organizations that have disclosed data. We utilized publicly available information such as published prices to help quantify. While we kept very specific data in a complex matrix for calculations, we only shared cumulative benefit revenue stream totals with the public in our report (Smardon & Gavitt 2017).

2c. Data Collection for water based recreational activities:

For estimated revenue streams for water-based recreation activities such as swimming, fishing, boating, kayaking, wildlife viewing, etc. we researched quantity of participation and applied an appropriate *experiential value* per user based on researched data and *travel cost* estimations. We were able to make use of records kept, general observations, plus previous and current surveys. In cases where these activities also required investment in equipment, or storage fees (such as boating), those costs were established while contacting local businesses and organizations, and input into an extended matrix, so that costs were not "double counted".

3. Property Value Comparison Assessment:

For this portion of the study, we wanted to determine the extent of fiscal impact Cazenovia Lake has on surrounding property values and how that translates to a community benefit in the form of property tax contributions. First, we needed to establish that the lake indeed creates higher valuation. Second, we needed to isolate that benefit in a quantitative way. We utilized the *Hedonic Method* for these purposes.

3a. Lakefront community / Non –Lakefront Community Comparison:

First we compared the Town of Cazenovia with a local non-lakefront community. For this municipal comparison the Town of Sullivan (with the Village of Chittenango residing within) was selected as a comparison community to measure property value differences. This municipality was selected because it has a similar (slightly closer) commuting distance to the regional hub of the Syracuse area for jobs and business. While this community possesses some lakefront properties on the far north boundary fronting Oneida Lake, the community/village itself is not centered around nor particularly close to the lake. Since it is in a similar direction from the city of Syracuse, it can be assumed that residents from both Sullivan and Cazenovia townships have similar access to jobs, shopping, and other cultural and utilitarian services of the regional center. The fact that the town of Sullivan has only one established village also makes it comparable to the Town of Cazenovia. The overall rural character is similar as well, with the largest difference being the flatter terrain of Sullivan.

We were able to access GIS data including tax assessments for all properties in both townships for the year 2015. We also had a comparison of most recent real estate sales for comparable housing done by a local real estate agent to confirm the differentials from the tax data. We were able to establish from this data the differences in values between the two communities.

3b. Property Zone Assessments:

We also needed to extract the local differential in real estate values associated with proximity to the lake resource. To accomplish this, we assigned all properties in the town of Cazenovia to one of four zones (see Figure 2). Tier one (Lake Frontage) consists of all property with direct frontage on Cazenovia Lake. Tier two (Lake Influence) consists of properties in close proximity to the lake, as such to have views to the lake or to lakefront homes. Properties assigned to this zone had road frontage on the main roads that circle the lake or land between those roads and Lake Frontage properties. The roads include: Forman St. to East Lake Road to North Lake Road to West Lake Rd. to Rt. 92 (Syracuse Rd) to Rt. 20 (Ledyard Ave.). Tier three consists of all remaining properties that fall within the village limits. And tier four consists of the remaining town parcels. We again employed GIS Data mapping and property tax assessment information for 2015. We were able to isolate data by zone and compare for analytical purposes. Each zone was analyzed individually for total assessed value as well as average assessed value.

To determine a value benefit, we calculated the difference in property tax contributions for tier one and tier two (lakefront and lake influence zone) properties compared to an alternate scenario where those same properties were assigned the average real estate tax assessments of the remaining tier 3 and 4 properties. The collective amount the tier 1 and 2 properties pay above the average was associated as lake benefit revenue.
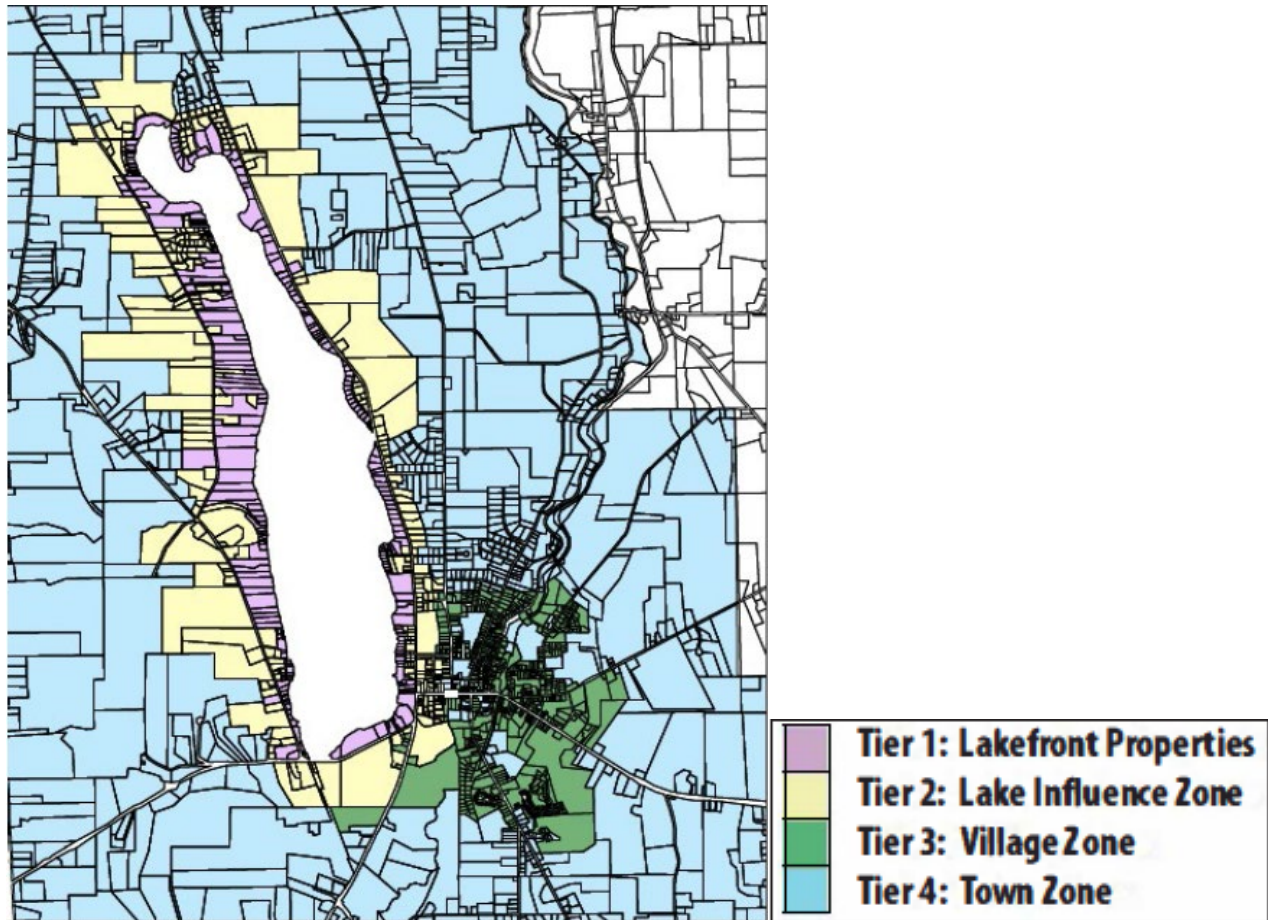
Figure 2: Area map of Cazenovia Lake showing major zones.
Source: Smardon & Gavitt 2017, p. 63

3c. Community tax rate comparison

As a result of our findings of the tax benefit for the community associated with higher property values near the lake, we decided to do a comparison of local property tax rates for surrounding communities, including lakefront and non-lakefront communities. We wanted to see if there was a correlation of overall lower tax rates for lakefront communities. We were able to find data through publicly available information on several local municipalities to make comparisons and correlations to other lakefront and non-lakefront communities.

5. Public Suvey

A random survey (stratified for lake edge, village and town residents) was designed to determine how the community members valued the lake. We hoped to gain a better understanding of the public's use of the lake, perception of the lake, and values pertaining to lake issues. Most importantly, we hoped to gain an understanding of what it is worth to local residents to maintain the health of the lake. For this particular question, we utilized the *willingness-to-pay* method to determine how much residents were willing to tolerate in increased taxes to prevent lake quality degradation such as decrease in water quality, decreased ecological health & habitat, increased shoreline development, and increased water based recreation activity.

<u>Survey Design and Administration:</u>
The survey was created through the website service SurveyMonkey.com. Once the survey was compiled and tested, it was made live for data collection. A front-page article in the *Cazenovia Republican* as well as outreach through social media was used to publicize the survey. This method of distribution yielded 272 completed online surveys. The survey was also produced in print copy for face-to-face data collection. This survey was made available at the local public library. Students also manned tables outside the local drugstore to distribute surveys. 44 hand surveys were collected. In total, 316 surveys were completed. Most of the surveys were completed by local residents of the township and village, with handful from neighboring communities. Just over 20% of the respondents indicated ownership of Cazenovia lakefront property.

Results

The results of the value stream analysis for the Cazenovia Lake to the waterfront, village residents and town amounted to more than **$10.5 million** a year. Significant contributing streams include the resource dependent category that included local businesses totaling about **$5.4 M.**

The next most significant benefit stream came from local property tax revenues associated with increased property values. This totaled **$3.6 M** a year. The following chart shows a summary of information from the tax data collected. From this analysis we were able to conclude that:

- Lakefront properties constituted 7.7% of taxable properties but contributed 20% of the total tax assessment.
- Lakefront and Lake Influence zones constituted 18% of taxable properties and 33% of total tax assessment.
- The Town of Sullivan compared to the Town of Cazenovia with an overall average assessed property value of $112K to 212K.

Map	Reference	Data Set	total assessment	# taxable parcels	avg. value/ parcel	assmt of tax free parcels	# tax free parcels	Avg. tax free parcel
1	tier 1	Cazenovia Lakefront properties	$138,862,400	251	$553,236	$7,822,400	13	$651,866
1	tier 2	Lake Influence zone, excludes tier 1	$88,574,034	333	$265,988			
1	tier 3	Village of Cazenovia excluding tiers 1 & 2	$149,385,287	796	$187,670			
1	tier 4	Town of Cazenenovia excluding tiers 1,2 &3	$309,199,741	1847	$167,406			
		Combined Town of Sullivan & Village of Chittenango	$792,683,523	7057	$112,325	$56,436,850	238	$237,129
2	town tax base	Town of Sullivan (excluding village)	$593,576,405	5239	$113,300			
2	village tax base	Village of Chittenango	$199,107,118	1818	$109,580			
	Tiers 1,2,3,4	Combined Town/Village of Cazenovia	$686,021,462	3227	$212,587	$62,931,400	186	$338,340
2	town tax base	Town of Cazenovia only (excluding village)	$490,034,425	2326	$210,676			
2	village tax base	Village of Cazenovia only	$195,987,037	901	$217,511			

Fig. 3. Property Assessment Analysis. Source: Smardon and Gavitt 2017

Significant results from the web-based survey included:

- For lake function - most respondents indicated that maintaining water quality and aquatic wildlife habitat was most important;
- In terms of frequency of lake related activities –the highest percentages were for passive recreational activities such as walking near the lake and watching the wildlife;
- For lake management concerns - the highest statement of concern was for maintaining water quality, the lake's contribution to quality of life, and the lakes economic benefit contribution;
- For a hypothetical tax increase - all survey respondents were willing to pay for maintaining water quality and controlling aquatic nuisance vegetation; and
- In terms of survey background – a surprisingly high percentage of residents are part of an environmental or civic not-for-profit which indicates a high degree of civic involvement.

Discussion and Conclusion

This study indicates the feasibility of assessing ecosystem services and multiple value streams of a freshwater lake to the immediate lakefront owners, visiting lake users, village residents and town residents. This lake provides substantial value streams yearly to all users and even to town residents who do not directly use the lake. Such an approach can be used to assess other green and bluescape areas. In this case the supporting foundation was hoping that the lake provided such benefits beyond the immediate lakefront property owners and therefore provided a rationale in broad community support to maintain the ecological health of the lake.

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