DETERMINING THE FULL VALUE OF NATURAL RESOURCES

October 2010

David C. Bier, Futurity, Inc.; Megan Lewis, JFNew;
Sam Miller, University of Notre Dame; and Sabina Shaikh, RCF, Inc.

Introduction

Costs to provide essential public services, such as drinking water, wastewater treatment, and stormwater management, often strain municipal budgets. In response, communities are increasingly looking for alternative ways—beyond traditional infrastructure investment—to provide these services. One cost-effective option is to rely on the resources and processes that natural resources can supply. These functions, often called ecosystem services, can complement—or even offset—traditional infrastructure.

There are numerous ways that natural resources provide infrastructure services. They can

- collect stormwater during rain events and treat it before it is released into groundwater or surface water
- reduce the impact of floods and even prevent them from happening
- conserve water supply by reducing demand and protecting water quality
- manage climate and reduce "heat island" impacts

Ecosystem services have direct economic value, because they help reduce demand for resources and in turn reduce costs. For example, trees provide shade, reducing ground surface temperatures and subsequently reducing energy demand for cooling. Natural resources also generate indirect economic benefits when they provide open space amenities and quality of life improvements. While natural resources provide multiple functions that have economic value, historically their ability to do so has not been fully accounted for. As a result, this value has not commonly been factored into planning and decision-making processes. Work performed in the late 1990s by environmental economists to determine the monetary value of ecosystem services have estimated a global average value of $33 trillion annually (in 1997 dollars).[1]

Because of an increasing awareness of the important role that natural resources play in providing critical community services, new planning tools and valuation methods are emerging that consider

[1] http://www.sustainablesites.org/report/The%20Case%20for%20Sustainable%20Landscapes_2009.pdf

these resources. These techniques provide a way to quantify the value that is added by ecosystem preservation and restoration projects and the economic impacts of ecosystem degradation and loss.

For decision-makers, having a better understanding of an area's capacity to supply ecosystem services, and the value of that capacity, allows them to better compare development alternatives. By more fully understanding the risks and costs of ecosystem impairment, decision makers can make better informed choices and achieve more sustainable economic development on the local and regional levels.

This paper outlines an ecosystem services planning and implementation process. Figure 1 shows the phases included in building this decision support platform.

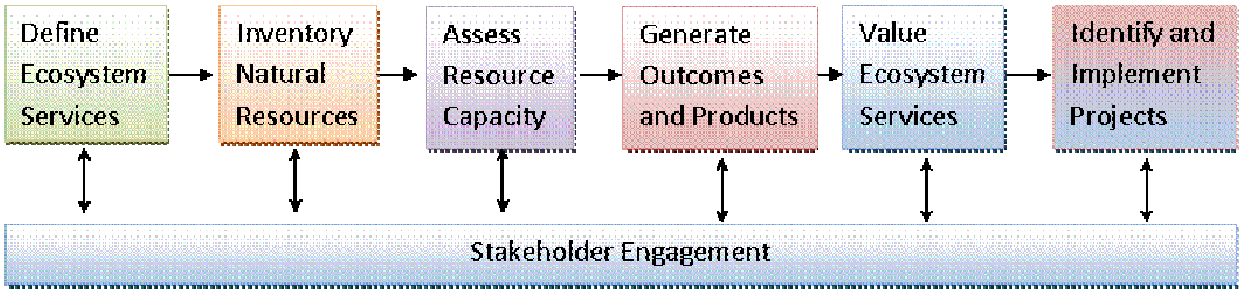

Figure 1: Natural Resources Assessment and Valuation Process. Source: JFNew, Inc.

This process can help a municipality identify ways to maximize the value received from its natural resources, both today and in the long term. The net objective is a development and conservation plan that can lead to integrated achievement of economic, environmental, and social goals.

Throughout this process it is important to engage stakeholders at each step, to ensure that all involved help define the natural resources, their potential services, the barriers to be addressed, and the goals to be achieved. In this paper, as each step in the process is discussed, suggestions on engaging stakeholders are included.

Phase I: Define Ecosystem Services

At the beginning of the planning process, there needs to be a robust understanding of what ecosystem services are involved, particularly in the context of the project's location. Ecosystems can generate a range of services that can be relied upon at the specific site level, at the larger community level, and even on the global level. Understanding these services and the scale at which you are working is an important first step to take.

To help take the concept of ecosystem services from an abstract idea to something concrete, a group called the Millennium Ecosystem Assessment has developed some examples of ecosystem services, based on the idea that they can provide, regulate, support, or enhance a variety of functions. Figure

2 provides some examples of what these functions can include. Note that a particular resource may provide one or several of these services.

Provide	Regulate	Support	Enhance
Fresh water	Flooding	Water table recharge	Recreation
Food	Water quality	Nutrient cycling	Culture
Fiber	Erosion	Species survival	Aesthetics
Energy	Air quality		Architecture
Biochemicals	Pests		Education
	Disease		
	Natural hazards		
	Climate		

Figure 2: Examples of Ecosystem Services. Source: Adapted from the Millennium Ecosystem Assessment.

Some of these services are straightforward to understand: for example, wetlands provide flood regulation, water purification, climate management, water table recharge, recreational services, and aesthetic services. Others are more complex, such as the ability of a species to help cure diseases or to create conditions that are conducive to the needs of future generations, such as soil health. Depending upon the goals of the project, the key stakeholders, or other factors, a wide variety of services can be defined.

- *At the beginning of the process, identify the key stakeholders to involve, including community members, interest groups, agencies, and elected officials.*
- *Engage community members to develop a common vocabulary on ecosystem services and identify broader community goals.*
- *Establish relationships with interest groups, agencies, and elected officials to understand needs and project requirements.*
- *Determine if project is part of a larger planning activity or involves a separate implementation plan.*
- *Be consistent with other plans.*

Phase II: Inventory Natural Resources

A natural resources inventory documents the presence of any natural resources and their ecological relationships. Natural resources occur in different forms: they can be a pristine prairie remnant that can be easily identified. They can also be an area with no native plant community present, but with natural and undisturbed underlying soil horizons that have habitat restoration potential.

A comprehensive inventory identifies these assets and might include:

- General plant communities
- Critical or important species
- Certain soil types
- Hydrologic features
- Topographic features
- Protected open space

In the past, creating natural resources inventories was difficult due to lack of data. In addition, the data that were available were often not available in electronic geographic information system (GIS) format or at appropriate spatial resolutions.

Today, the required spatial data can often be obtained through federal and state web-accessible data servers, making the process much easier. Also, much of this information is now available as GIS shapefiles, which are files with tables of data and the information to display that data correctly as a spatial image. Some data, such as the location of plant communities, may need to be mapped by analyzing multi-spectral aerial or satellite imagery. Some information may also need to be collected in the field (for example, through ecological assessments) or converted from hardcopy to GIS format. Despite these additional steps, the data are now available or easily accessible for a comprehensive natural resources inventory.

The inventory is often completed by compiling data in a GIS or a geodatabase, which stores, queries, and manipulates geographic information and spatial data. The table structure of a geodatabase allows data to be used more efficiently and accurately.

- *Engage stakeholders to help with the inventory process and provide existing GIS data layers.*
- *Consider using students or other volunteers to do field data mapping work.*

Phase III: Assess Natural Resource Capacity

While natural resources have innate ecosystem services, their ability to provide those services is often lessened by land-use activities. When assessing the capacity of natural resources to provide ecosystem services, it is important to document those factors that cause positive and negative impacts to develop effective land management strategies.

Impervious cover is a prime example of a factor or condition that can have negative impacts. Stormwater runoff that is discharged from impervious land cover can add pollutants to an adjacent water body or cause excessive runoff.

Another example is invasive plant species. These species, such as *Phragmites australis* (common reed), can suffocate native plant communities and degrade habitat, which in turn can interrupt food chain relationships and cause a decline in species diversity.

External conditions and activities can also have a positive impact on natural resources. They can help maintain the quality of natural resources or ensure they are protected. For example, it is important to document land restoration activities that improve habitat quality and legal mechanisms that limit land development. It is also important to document any elements of zoning ordinances and other regulations that impede the full capacity of these resources.

- *Talk to stakeholders about what have historically been issues in the community. They may have anecdotal information that could lead to discovering other issues.*
- *Work with local government officials to identify mechanisms in place that are impeding any natural resources functions.*

Phase IV: Produce Analysis Outcomes and Products

The first three phases shed light on the assets that are available and the factors that either support or hinder them from providing their services. To guide this process, it is important to identify desired outcomes and products. This step should occur early in the process, so that all activities support the outcomes.

The desired outcomes can have many forms. For example, they could include:

- An understanding of the location, extent, condition, and importance of natural resources for the particular project.
- An understanding of the impacts that conditions and activities are having on natural resources, in preparation for identifying solutions
- The capacity to prepare a comprehensive assessment of the aggregated impairments to ecosystem services that have occurred as a result of human activities

The products that could be developed to support these outcomes might include:

- A translation of ecosystem service values into quantitative information
- A geodatabase to manage and integrate spatial information
- Maps of assets and threats
- Diagrams defining positive and negative relationships between assets and threats
- An assessment of where and how natural resources have been degraded in recent years

These outcomes and products provide the foundation upon which cost/benefit analysis and natural resource management plans can be built.

- *Present these outcomes and products to the community at a public meeting, at a school venue, or other public mechanism.*
- *Allow for questions and comments, and be open to changes. The goal is for the stakeholders to own the process and the outcome along with the project leaders.*

Phase V: Valuing Ecosystem Services

To give outcomes and products the weight they need for decision-making purposes, the underlying natural resources need to be given quantifiable value.

When natural resources are seen as a form of capital, and their services are given accurate economic value, planning models can be transformed to fully account for investment in ecosystems protection. This process requires identifying the relationship of ecosystem structure and function to human behavior. Developing the link between ecological production and economic valuation is imperative to affect how humans interact with natural resources through policy and planning mechanisms.

Models that are currently used for valuing economic impacts can also be used for natural resources valuation. One tool used to measure the economic impact of investments, including public investments in natural resource restoration and conservation, is ***Input-Output (I-O) Analysis.*** Used by municipal planners and budget managers, I-O analysis measures job impacts, income changes, and spending changes related to local or regional economic development. The I-O tool most commonly used to measure economic impacts related to natural resources is IMPLAN (Impact Model for Planning), which the U.S. Forest Service designed for community impact analyses. The USDA Natural Resources Conservation Service uses this model extensively to estimate economic impacts for watershed analysis, conservation initiatives, and local natural resource planning.

In addition, there are advanced methods for valuing ecosystem goods and services that rely on extensive data collection, usually through surveys. These methods include Property Method Valuation, Travel Cost Modeling for Recreation, and Contingent Behavior Method. Because they require significant economic expertise and funding, primary valuation studies have traditionally been left to researchers.

Fortunately, several methods exist that use existing studies and apply those estimates to specific cases. These cost-effective alternatives provide techniques that local and regional governments may use immediately. Examples of these alternatives, including input-output analysis, include:

- Avoided costs
- Replacement costs
- Benefit transfer
- Meta-analysis

Avoided Costs

Ecosystem benefits can be measured by the costs avoided by the services they provide. Examples of such avoided costs include reduced infrastructure spending on flood control, water treatment costs associated with storm events, and energy costs associated with heat island effects.

Replacements Costs

Similar to avoided costs, replacement costs are the costs of replacing ecosystem services from wetlands, beaches, and green spaces with build infrastructure solutions. Market prices and engineering costs are two readily available sources of these types of costs and benefits.

Benefit Transfer and Meta-Analysis

Both benefit transfer and meta-analysis can be used with avoided costs or replacement costs to capture a full economic value of ecosystems. This step goes beyond cost data to include quality of life improvements associated with recreation, aesthetic improvements, and civic engagement, for example. While the data used for benefit transfer and meta-analysis come from existing economic literature, with careful adjustments they can be used for specific projects. The accuracy and reliability of economic value estimates can be greatly improved through integrated ecological data collection and economic valuation, which to date has not been widely applied in planning frameworks.

- *Engage stakeholders in this process, to identify the best method to use to determine the values.*
- *Keep them involved and informed throughout the analysis, to ensure that the process remains transparent.*

Phase VI: Identify and Implement Projects

Once the outcomes, products, and natural resource values have been generated, this information forms a decision-making platform to help identify specific projects to undertake. This process can be achieved through a comparative analysis, where the natural resource assets are compared with

each other in terms of their benefits. When presented in a comparative matrix, the alternatives can easily be evaluated. This analysis can be further refined by incorporating additional layers of data on elements that impair or enhance the value, or have other external influences.

Developing maps that represent the alternative scenarios is an additional way to display this information for decision making . Decision makers can then use these maps to choose the option that will work best for them.

These alternatives can be evaluated on their own or as part of a comprehensive planning process, local or regional, to ensure that this information is incorporated into plan outcomes. They can also be used as part of plan implementation tools. One of the most powerful tools are capital improvements plans, which implement the construction and renovation actions that require public funding. Including the outcomes from a natural resources valuation process into an established plan helps to ensure that this process becomes reality.

- *Involve stakeholders in this alternatives analysis, to identify the scenarios that address the community needs or issues.*
- *Ensure that any actions taken are consistent with existing planning and implementation mechanisms.*

Conclusion

Natural resources valuation is a decision-making tool. It provides a pathway for community members and leaders to understand what resources they have, what those resources can do, and how they can capture these functions and employ them to address specific problems or situations. It can also help focus conservation, restoration, and mitigation efforts.

To make this option a reality for communities, funding is needed to support pilot projects and create models for other communities to emulate. Because communities can take this approach with existing data and studies, it can be a cost-effective way to determine how the natural resources of a place are in fact the optimal solution to address one or several community needs. As more places seek to go from gray to green infrastructure, natural resources valuation will be necessary to make sure these projects are truly successful.