Towards a More Sustainable Lake

Dr. Jennifer L. Jermalowicz-Jones
Science Advisory Chair, MLSA

WHAT IS A SUSTAINABLE LAKE?

The technical definition for sustainability is: "to be maintained at a certain rate or level". This definition is crucial for determining long-term lake health. Inland water resources will continue to face development pressures as it is projected that by 2030 there will be nearly 5 billion people residing in urban centers (United Nations Population Fund, 2007). Unfortunately, a large lake size is preferred by most riparians for recreational and visual benefits (Smith and Mulamoottil, 1979), and it is these systems that can accommodate the most development (Schnaiberg et al., 2002) and also possess the greatest probability for pollutant and invasive species entry (Figure 1). Ultimately, both the aquatic ecosystem and the riparian community are harmed, as degradations in water quality also result in a loss of property values (Michael et al. 1996, among many others). While it is possible that a lake could be maintained at a sub-optimal level, such a state is not preferred by most lake riparians and could compromise the trophic status of an inland lake (Figure 2).

A sustainable lake ecosystem should ideally have the following characteristics:

1. Minimum dependence on humankind for maintenance to continue to thrive in a balanced, long-standing state, and
2. Resilience—which is the ability of the lake to "bounce back" or recover after a significant disturbance (e.g., pollution, invasive species, algal blooms, etc.), and
3. Remain as close to its original state as possible.

Donald Kennedy (2003, Science magazine editorial comment) previously stated that sustainable ecosystem management is dependent upon the ability of scientific facts to overcome socio-economic and political resistance. This argues for lake management methods to be supported by the scientific

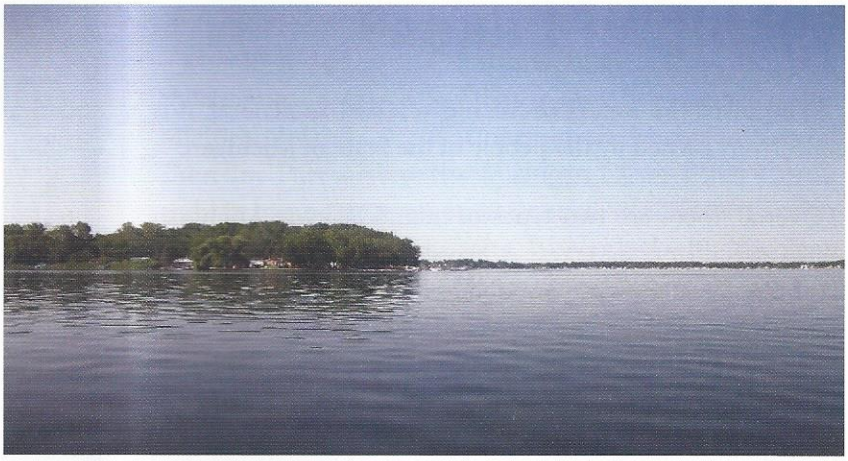

Figure 1. A sustainable, balanced lake ecosystem.

Figure 2. An unsustainable, imbalanced lake ecosystem.

community. It is possible that some methods may be utilized by lake managers but not extensively studied in a research setting. Such methods should be supported as long as existing data/results are strong and the riparian community supports use of the method(s). This is especially important because lake degradation issues are evolving more rapidly than research capacity and needs to correct these issues are imminent.

A thorough understanding of the lake problem and its relationship to society and water resources is critical for the advancement of sustainable governance policies. Furthermore, a sustainable approach to these problems should consider a balance of lake usage with the protection of lakes (Carpenter and Lathrop, 1999). It is even more important for the lake community to not be too dependent on legislative action(s) since such proposals take considerable time to pass and are often followed by lack of enforcement. Significant improvements to legislation are needed globally to effectively address anthropogenic (man-made) impacts and

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other stressors on water resources, especially in reference to agricultural areas where the primary goal of land use is for yield production and not necessarily for water resource protection and recreation. Around the globe, many lakes are experiencing blue-green algal blooms due to nutrient loading from agricultural and urban runoff.

SOME RECOMMENDATIONS FOR A SUSTAINABLE LAKE MANAGEMENT PROGRAM

If the model proposed by Feeny et al. (1990) is followed, sustainability of any lake improvement program must include both human and resource valuation which are not mutually exclusive. Furthermore, the socio-political structure of the riparian community that utilizes a resource and the interactions with the larger political system has impacts on managerial qualities of local groups in reference to the shared resource (Ostrom, 1988). Surface waters should then be considered a "commons" where management and policy implementation of lake improvement methods should consider the nature of the resource, decision-making strategies by stakeholders, property rights of riparians, and attributes of relationships among resource users and regulators (such as EGLE and MDNR). Due to the nature of this multiple ownership of the "commons", world views held by each stakeholder will have to be considered for significant advances in a program. Orr (2003) mentions that the transition to sustainability is more a function of social, political, and psychological behaviors than strictly a technological or scientific process. If this concept is implemented in the process of a lake improvement program, then the local governments and riparians can develop a mutualistic trust that would be derived from attentive exchange of personal values and the needs of the local government, the riparians, and the lake.

A sound support strategy was recommended by Middendorf and Busch (1997), which included public involvement in research a priori to establish common research priorities and increase a wider range of values in the decision-making process. These strategies may assist the riparian communities towards a sustainable program because public involvement combined with the expertise of scientific innovations would perpetuate a self-driven (sustainable) program where common goals can be continuously evaluated from metrics developed by all stakeholders. A measure of sustainability can then be assessed through the projected measurement of selected metrics over an extended period of time. For example, the metrics for a non-point source pollution control program may consist of measurements of pollutant loads and transport dynamics, changes in water quality parameters and indices of biotic integrity (IBIs), among many others. The metrics for an invasive species control program may consist of evaluating declines in the relative abundance, density, and locations of invasive species within the lake through intensive surveying and mapping. Similarly, metrics for a blue-green algae bloom management program may include quantification of blue-green algae and possible associated toxins before and after nutrient reduction strategies or other treatments. It should be cautioned that such metrics may be site-specific given the heterogeneity in surface water ecology; however, these potential outcomes emphasize the need for local governance and involvement

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for the long-term adaptive management of water resources. Changes in the perceptions of all stakeholders both before and after implementation of the lake management program may also be evaluated to determine the efficacy of the program in terms of sustainability and betterment of the local riparian community. The evaluation process should be initiated by an independent party and sound science to assure that conclusions are not obscured by influences of political agendas, world views, or biases.

Although it may be useful to dissect the components and operations of other lake management programs, it would be wise to form a new program through the lenses of multiple viewpoints possessed by the stakeholders. The primary research problems or objectives will ultimately determine the critical aspects of a program which allows an objective structure to serve as the foundation of the program and for everyone's objectives to align. Sustainability of a lake management program will then ultimately depend on the ability of the objective program structure to adapt to community and governance needs and lead to lake improvement. A successful program for lake management would likely harbor the many characteristics described above with regards to stakeholder dynamics and composition, local governance, and objectivity of the determined research problems. With the increases in human population around water resources and the pollution thresholds of many surface waters exceeded, current legislative Acts must also incorporate prevention and monitoring into sustainable recommendations for lake resources.

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