

Case Study on North American Great Lakes (Jeff C. Ho, Stanford University)

Introduction to the transboundary river basin/lake/aquifer

The Laurentian Great Lakes between Canada and the United States are a series of interconnected lakes that together form 21% of the world’s surface freshwater. They are the largest group of freshwater lakes on Earth. The five lakes (Superior, Michigan, Huron, Erie, and Ontario) cover an area close to 250,000 km² (roughly the size of the United Kingdom) and the watersheds draining into the lakes cover over 750,000 km² (roughly the size of the U.K. and France combined).

Within the basin, the largest cities are Toronto in Canada and Chicago and Detroit in the U.S, with more than eight million Canadians (over 20% of the country’s population) and thirty-five million Americans (over 10%) living in the basin overall. The different watersheds vary in terms of urbanization, ranging from over 90% forested (Superior) to less than 25% (Erie). In watersheds with less forest cover, agricultural land is dominant. The main economic drivers are agriculture and manufacturing, with the lakes playing an important role in providing a shipping corridor, a drinking water supply, a source of commercial fish, as well as opportunities for tourism and recreation.

The main environmental issues are water pollution in the lakes, with biological (harmful algae) and chemical (toxic contaminants) concerns the main issues over the past forty years. More recently, the challenges posed by invasive species and climate change, in addition to a growing need to protect species habitat, have drawn more attention as well. These issues are managed at a local level supported by a bi-national framework headed by a joint commission overseeing new science and cross-border collaboration. A well-informed public, acting through non-governmental agencies and other boundary organizations, push local authorities to act on issues promulgated by the joint commission.

Description of the process of transboundary water cooperation

Formal transboundary water cooperation in the Great Lakes began with the 1909 Boundary Waters Treaty signed between the two federal governments in response to disputes over navigable water rights and waterway modification through dams. Cooperation expanded with the 1972 Great Lakes Water Quality Agreement (GLWQA), signed in response to the then-growing nutrient pollution problem. The GLWQA was amended several times, with renegotiations in 1978 in response to the problem of toxic contaminants, in 1983 and 1987 solidifying previous environmental gains, and in 2012 in response to species habitat, invasive species, and climate change concerns¹.

The 1909 treaty created the International Joint Commission (IJC) to act in cases jointly referred to it by both parties (but with no formal legal authority). The bi-national IJC investigated various water pollution issues in the early decades, slowly gaining legitimacy from both countries as a resolution mechanism and environmental authority. The GLWQA expanded the role of the IJC, giving the commission power to initiate its own strategies rather than wait for issues to be referred to it. This ushered in the creation of two science advisory boards to advise the IJC on scientific issues and foster cross-border scientific collaboration. The ongoing transboundary water cooperation is built on a century of peaceful collaboration between the two countries in addressing common environmental issues through the IJC and its bi-national science advisory boards.

¹ More detailed histories exist, and so this section should be considered a brief summary drawing on several other historical perspectives, including Bilder (1972), Manno (1994), Donahue (1999), Krantzberg (2012), and Fryefield (2013).

Benefits of transboundary water cooperation

The primary environmental benefits in this case were scientifically-guided recommendations to address the two main issues: nutrient pollution and toxic contaminants. Following the 1972 GLWQA, scientific studies identified nutrient pollution coming from wastewater treatment plants and phosphate detergents as the culprit behind harmful algal blooms. With their subsequent control through federal regulation (phosphorus targets ranging from 5-15 µg/l in each lake), nutrient concentrations were successfully reduced by 1984 (e.g., in Lake Ontario, phosphorus was reduced from 25 µg/l to 10 µg/l (SOLEC, 2009)). For toxic contaminants, a similar process following the 1978 renegotiation resulted in significant declines of critical contaminants. (e.g., polychlorinated biphenyl (PCB) concentration declined almost ten-fold between 1980 and 1993 in Lake Michigan in both water (from 1.8 ng/l to 0.2 ng/l) and in fish (from 22.9 ng/g to 2.8 ng/g) (De Vault *et al.* 1995)).

These outcomes benefitted not only the environment but the economies dependent on the environment, including commercial fishing (worth over \$91 million in direct and indirect sales value), sport fishing (worth \$7.5 billion in money spent on trips, boats, travel and tourism), recreational boating (worth \$2.2 billion), and beach use (worth \$200 million) (Krantzberg & De Boer, 2006). Some legal scholarship also suggests that the cooperation over water issues allowed for subsequent geopolitical benefits, for example in protecting transboundary water resources thereby silencing one concern of the North American Free Trade Agreement (Khakee, 1992), although such benefits are more difficult to establish and quantify.

Other social benefits were also created through the mutual cooperation over water issues. These were a) greater cross-border cooperation between government agencies and scientists through the bi-national science advisory boards; b) increased transparency and accountability of federal activities brought about by increased public engagement; and c) the emergence of strong non-governmental organizations (NGOs) in response to the non-binding authority of the GLWQA and the need for linkages between federal and local policy. These benefits were indirectly created through the process of environmental problem-solving, but were nonetheless integral to the successful realization of environmental benefits.

Have the parties needed/requested an assessment of the (actual or potential) benefits of transboundary water cooperation?

Assessment of environmental benefits occurred periodically through a review process stipulated in the GLWQA. In this process, the science advisory boards on instruction from the IJC would study whether the environmental situations had improved or not and, if not, what could be done to address the pollution issues. For example, during the 2006 review process, one working group found that biodiversity was not being adequately protected and so recommended explicit language for protecting biodiversity in an upcoming amendment (Krantzberg, 2012). The level of evidence required for such recommendations depended on the individual working group; the IJC relies on the expertise of the science advisory board experts in justifying action on specific environmental issues.

In contrast, no formal review of social benefits by the parties has occurred. Such benefits have instead been identified by researchers in the academic literature (e.g., Manno, 1994, Donahue, 1999 or Krantzberg, 2012). Similarly, while economic assessments of the *value* of the water resources have been requested, no formal review of the economic *benefits* of cooperation has occurred. That is, economic valuation has occurred to motivate cooperation, but not to subsequently identify the benefits derived from cooperation (Krantzberg & De Boer, 2006).

How were the benefits estimates derived?

The environmental benefits were estimated based on data from water quality and fish samples taken on the lakes. Local government agencies take samples in areas of concern, which are determined by IJC science advisory boards to have significant water quality impairment. These local data sets are sometimes supplemented by state- or province-level agencies which operate sampling cruises around the Great Lakes. These agencies – the Environmental Protection Agency (EPA) in the U.S. and Environment Canada (EC) in Canada – collaborate to maintain a series of sampling stations for which data on water pollution is collected.

These data are collected and analysed using standardized methods as per the guidance of their respective environmental agencies. For example, the US EPA promulgates standard methods for measuring chlorophyll concentration, an indicator of biological productivity, which are used widely by other agencies and academic researchers. More recently, these government agencies have incorporated satellite imagery to estimate water quality as well, for example in estimating harmful algal bloom extent, but standardized methodologies for integrating satellite estimates are still being developed. Current use of remote sensing is evolving with increased understanding of best practices published in academic literature (e.g., NOAA (2014)).

In contrast, the social benefits have mainly been estimated using techniques from the academic social sciences. The most common are in-depth case studies where scholars trace the history of legal, political, and/or regulatory changes in the Great Lakes and identify important factors for success and/or failure. For example, the NGO Great Lakes United was identified as having played an integral role in the 1987 GLWQA renegotiation by insisting that the primary language of the Agreement was kept unchanged (Manno, 1994). The second most common technique is a comparative case study, where the case history is compared with others to identify common factors of success and/or failure. These approaches draw upon in-depth interviews with key stakeholders and public data from citizen hearings. Although such studies are not primarily directed at estimating benefits, they nonetheless provide valuable information on the social benefits of transboundary cooperation. This approach has had success at identifying such benefits, but has not been able to explore, for example, the potential inclusion/exclusion of marginalized groups in the public consultation process. As such, the scope of current social benefits assessments has been limited.

For economic valuation of the Great Lakes, reports such as Krantzberg & De Boer (2006) have focused on use value (e.g., direct use of fish for consumption), option value (i.e., willingness to preserve option to use environment in the future), and existence value (i.e., willingness to pay for preserving resources that one will never use). These are determined by observable (e.g., prices on the market for fish) and hypothetical (e.g., surveys on willingness to pay) methods from the social sciences.

Benefits assessments in the Great Lakes have been published both by government agencies and in peer-reviewed journals. Environmental benefits assessments are most often published in non-peer-reviewed government agency reports. However, due to the use of standardized methods used in such assessments, there has been little criticism of their legitimacy (they have also benefited from authors publishing the benefit assessment results in peer-reviewed journals). In contrast, the social benefits in the case have exclusively been published in peer-reviewed literature due to their assessment having been almost entirely performed by academic researchers. Despite publication in peer-reviewed journals, information on the social benefits has been less influential and convincing, possibly because of the more difficult-to-quantify findings that have resulted.

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How were the benefits assessment's findings communicated?

For the environmental benefits, the assessments' findings were communicated during the periodic review process and during the forums for outreach created for the renegotiation process. In these processes, advisory boards to the IJC consult with different government agencies to assess whether the environmental benefits are being realized and then later communicate the results to NGOs and the public at large.

The review process incorporates discussions with government agencies such as the EPA and EC, in addition to local civil servants such as regional water quality managers, to assess regulatory compliance. This process also involves NGOs, and the communication of environmental benefits to NGOs through this process in particular shapes their subsequent advocacy. Communicating with NGOs has in recent years been more difficult as the groups have become more diverse and numerous. For example, during the 1987 renegotiation, the IJC reached out only to three NGOs for comment while in 2012 there were over thirty-six citizens' groups who were consulted (Krantzberg, 2012). As such, the type of unified political voice observed in the 1970s and 1980s has been absent in recent decades (Krantzberg, personal communication).

Information on the environmental benefits (or lack thereof) has taken the form of water quality data and interpretation from government scientists. During the review process, water quality reports are disseminated and expert judgements from IJC advisory boards are interpreted. The mode of communication has changed with time: in 1987 the IJC organized a series of citizen hearings for consultation and dissemination while in 2012 a series of webinars was organized instead (Krantzberg, 2012). This has led to some comments of worsened communication between the IJC and the public (e.g., Krantzberg, 2012).

The ancillary social benefits, because they were mainly communicated through peer-reviewed journals, were not intentionally communicated to any specific target audience other than in academia. There has been some cross-communication of these benefits, for example in policy forums such as this workshop, but the social benefits have not been the subject of specific targeting campaigns such for the environmental benefits.

How were the benefit findings used by the target audiences?

Environmental benefit assessment findings have been used during the review process to motivate political action toward even better environmental outcomes. For example, negative reports on invasive species in the mid-2000s directly resulted in advocacy for including a provision on invasive species in the 2012 amendment (Krantzberg, 2012; Fryefield, 2013). Even when the benefit finding results were positive, stakeholders pushed for greater environmental oversight. In the 1978 renegotiations, for example, Great Lakes United advocated for a strengthening of regulations through new annexes on toxic contaminants rather than a weakening of the GLWQA because the nutrient pollution problem had been solved (Manno, 1994).

The social benefits found to be integral in supporting positive environmental outcomes have been used to better understand other transboundary environmental problems elsewhere. The strong role of NGOs in influencing bilateral negotiations; the confluence of factors that led to successful regulation; and the use of prestige to venerate science advisory boards as a tool for collaboration; these are all lessons learned from this case that have been used to inform and provide a model for other cases (See e.g. Manno, 1994; Bilder, 1972).

Have the findings of the benefit assessment been useful in strengthening the transboundary water cooperation process?

It is the perspective of many scholars that the findings of benefit assessments have been useful in strengthening the cooperation process for the Great Lakes (e.g., Manno, 1994; Fryefield, 2013). This has relied on credible findings and actionable solutions, both leading to an increased legitimacy for the governance framework in solving water-related issues. The credibility of the findings came from the collaborative strength of government science boards engaging with academic researchers and also from the long-standing history of the IJC as a problem-solving institution. In the nutrient pollution and toxic contaminant cases, the solutions were also highly actionable and relatively easy to implement with federal regulation. These two factors, in conjunction with public engagement for communication and implementation, have strengthened the GLWQA framework in the Great Lakes.

This strengthening of the framework has led to attempts to address even greater environmental challenges with the 2012 amendment. The focus on climate change and invasive species, two environmental issues with solutions involving global rather than local cooperation, will stress the current benefits assessment framework and the transboundary water cooperation process. New issues of environmental problems returning (e.g., harmful algal blooms returning despite lowered nutrient inputs in the last two decades (Michalak *et al.*, 2013)) will further challenge the GLWQA framework. Progress on these issues will be assessed prior to the next review, which occurred every six years prior to 2012 and will now occur every nine years.

There have been instances of social benefits findings influencing the transboundary cooperation process as well, but only in support of environmental benefits. For example, the process of local governments acting on remedial action plans promulgated by the IJC, an instance of improved national-local co-management, was codified in the 1987 amendment (Manno, 1994). Other benefits, such as increased public consultation on water issues, have not been incorporated into the formal process, leading to criticism from scholars (Krantzberg, 2012).

Key messages and lessons learned for others

Overall, the importance of the science advisory boards in promulgating scientifically – defensible recommendations (which could be advocated for by a motivated public) was integral in generating the environmental benefits in this case. They were aided though by a long history of joint problem-solving which led to increased legitimacy of the IJC as an institution. This legitimacy, combined with the motivated public which could advocate for local implementation of the IJC recommendations, provided a confluence of contextual factors which may make the benefits from this case difficult for others to emulate in the short-term. Still, starting from an environmental problem-solving approach and moreover allowing the public to genuinely affect the outcome of treaty negotiations, as the IJC did, would be a good start for other transboundary water cooperation efforts.

In terms of failures, sustaining the benefits of transboundary water cooperation has been difficult in the North American Great Lakes. Harmful algal blooms have returned after several decades of absence, and the inconsistent public consultation process during the recent 2012 renegotiations suggest that incorporating public participation in such transboundary cooperation may be difficult to sustain. These challenges come from new environmental problems (e.g., invasive species initiating the return of harmful algal blooms) and the increasingly diverse set of interests in the public sphere, both of which are unlikely to lessen in the future.

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The potential for improvement in the future will rely on solidifying the gains that have already been made in terms of regulatory structure and environmental monitoring, and finding ways to improve public participation mechanisms. Both of these paths will build on, rather than weaken, the legitimacy built up through previous success.

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