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Opportunities for increased hydropower diversion at Niagara: An sSWOT analysis

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ABSTRACT

Flows in the Niagara River are a pivotal resource that transcends the geographical boundary of Canada or the US. Every year the Niagara Falls attracts 12–14 million tourists while the river water, diverted in accordance with the 1950 Niagara River Treaty, is used for power generation and navigation purposes. The paper elaborates on the existing decision support frameworks by explicitly incorporate sustainability and shows how the new framework applies it to the strategic planning for the overall development of Niagara. The analysis sheds light on the current economic, environmental, social and political dynamics through the application of Sustainability SWOT (sSWOT) framework. The Analytical Hierarchy Process (AHP) and Analytical Network Process (ANP) are both used to identify a priority sequence among potential decision alternatives. The analysis shows that renegotiation of the 1950 Treaty is a preferred option over the current flow restrictions. This exploratory study does not attempt to forecast likely or advisable developments, but rather recommends further research on Niagara, ideally coupled with the opening of new discussions between Canada and the US.

1. Introduction

The Niagara River, an integral part of the Great Lake Basin, not only transports vast quantities of water but hosts a world-renowned waterfall, a spectacle that itself attracts 12–14 million tourists each year. The river water, diverted according to the 1950 Niagara River Water Diversion Treaty, renewably powers generation facilities on both sides of the Canadian-United States border. However, balancing the competing demands between recreational, commercial, and industrial uses within this river system has proven to be a challenge since at least the nineteenth-century.

Integrated Water Resource Management (IWRM) is defined as "a process which promotes the coordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems" [1]. IWRM moves from broad policy goals to selecting, implementing, and subsequently evaluating and revising suitable strategies. Resource management of transboundary water faces a specific set of challenges as conflicts on water resource allocation and benefit sharing are inevitably complex. Due to this nature, strategic action plans involving transboundary water should follow the simplest approaches, drawing from engineering, economics, ecosystem and social studies, but with the overall goal of being easily understandable to policy makers.

The existing literature references a number of decision support tools. The so-called SWOT approach (for Strengths, Weaknesses, Opportunities and Threats) originated from business literature [2]. The DPSIR approach (Driving forces, Pressures, States, Impacts, and Responses) is a causal framework for describing interactions between society and environment [3,4]. A closely-related but sophisticated variant called PESTLE (Political, Economic, Social, Technological, and Environmental) provides a multidimensional purview of the whole environment to track proposal-specific considerations [5]. Another document [6] introduced the CSDA, a combination of SWOT and DPSIR, for issues vexed with environmental and climatic uncertainties or economic instabilities. While the DPSIR framework lacks economic considerations – a major concern in resource management – the PESTLE focuses mainly on the external environment [7]. This paper uses the SWOT for its simplicity and ability to analyze both internal and external environmental factors, relatively easier but effective methodology, graphic representation and easy interpretation. The SWOT has been successfully applied in resource planning [8–10], ecosystem management [11–13] and strategy prioritization at the industrial and policy level [14–16]. Management of transboundary water system such as Niagara requires participation from a vast array of stakeholders.

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The nature of the analysis necessitates addressing the conflicting objectives of consumptive use, navigation, hydropower, tourism, erosion etc. The SWOT's ability to engage and involve stakeholders can be particularly beneficial for analyzing these systems.

Appropriate strategic action requires systems to be able to adapt and survive in a changeable environment. Since the conventional SWOT often fails to comprehensively appraise the decision situation, Kurttila et al. [17] developed a hybrid method using the Analytical Hierarchy Process (AHP) to accommodate the assessment of alternatives. However, recent studies [18–22] with the AHP application do not account for the possible dependencies among the underlying factors – a limitation which application of the Analytical Network Process (ANP) addresses.

Sustainable development, sometimes still referred in the classic way as “meeting the needs of the present without compromising the ability of future generations to meet their own needs” [23], has become an increasingly important consideration in resource management. Such considerations are motivated by obvious evidence of ecosystem degradation, natural resource depletion and global climate change. At present, we still need to find ways to incorporate sustainability into long-term resource planning in order to mitigate adverse impacts and to promote resilience. Here, the authors develop a framework based on the concept of a “sustainability SWOT” (or sSWOT) [24] which provides a specific sustainability dimension to the familiar SWOT considerations. The sSWOT analysis connects long-term environmental and social challenges with economic priorities and can communicate new policy insights. It is designed to drive action and collaboration on environmental challenges, creating risks and opportunities which otherwise may go unnoticed. The paper applies the AHP and ANP within the sSWOT framework for the purpose of assessing the potential for increased hydropower diversion at Niagara, which is an option that opens up with the expiration of the bilateral treaty between the two neighboring countries, the US and Canada. This exploratory study attempts to integrate the disparate and currently unconnected aspects/dimensions of water, energy, tourism and policy to promote sustainable development of the incredible resource system at Niagara.

2. Model development

A nine-step sequential evaluation process is used to analyze resource systems from sustainability perspective using the sSWOT (Fig. 1). First, specific objectives for resource planning are set, which in this case is to increase the hydropower potential at Niagara. Unlike the traditional SWOT which initiates with internal factors (strengths and weaknesses), the sSWOT begins with synthesizing information on the future environmental challenges and the changing policy landscape (step 2). Next, the analysis recognizes the threats and opportunities with respect to the observed challenges. Throughout the process, the benefits and potential risks changes may pose are considered. After identifying the external factors (opportunities and threats), the strengths and weaknesses of the existing system are articulated (step 4). The elements under each SWOT factor, called the SWOT sub-factors, are categorized into economic, environmental and social parameters in step 5. On the basis of the SWOT sub-factors, alternative strategies are proposed (step 6). Next, stakeholders' surveys are conducted to weigh relative importance among sub-factors and alternatives. In the final stages, survey data are analyzed with the application of AHP and ANP to obtain ranking of alternatives.

The application of AHP within the SWOT framework allows quantitative evaluation of the identified factors [25,26] and it has been widely applied in natural resource planning, industrial and

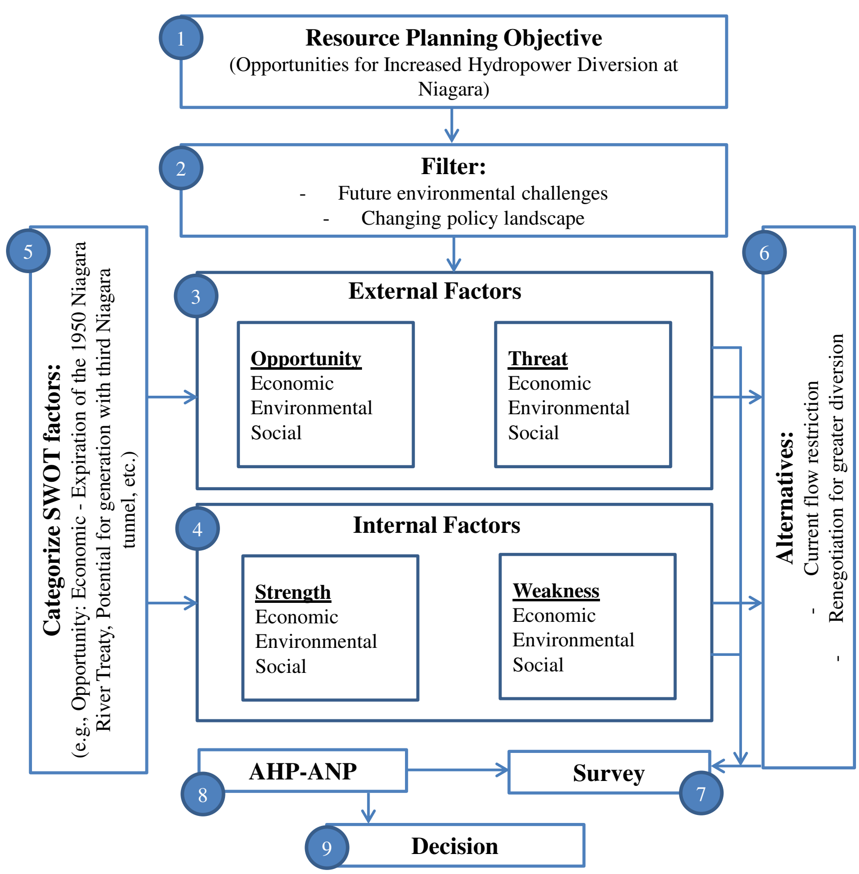

Fig. 1 Step-by-step evaluation process for the sSWOT model..