

Building Stronger Social and Ecological Communities in the Muskoka Watershed

Elaine Ho¹, Sondra Eger² and Simon Courtenay³

^{1,2} PhD students, Social and Ecological Sustainability (Water),
School of Environment, Resources and Sustainability, University of Waterloo
³ Professor, School of Environment, Resources and Sustainability, University of Waterloo



Introduction

Current efforts to address climate change are focused on mitigation^{9, 10}, though recent discussions (such as the Vancouver Declaration signed March 3, 2016) are shifting some priority to adaptation. As such, many regions are already integrating climate change adaptation into current decisions, including considering the implications of predicted climatic changes (e.g. Lake Simcoe, Lake Superior).

The Muskoka region is already experiencing changes to its land, water and air. The quality of Muskoka's waterbodies is a priority, as drinking water, angling, biodiversity, and recreational activities all rely on it⁶. In this summary we explore options for more comprehensive water management strategies that will increase the region's ability to mitigate and adapt to the impacts of climate change. We do so with a focus on two recommendations (highlighted on p.6 of this report) provided by Sale et al. (2016). We aim to assist the Muskoka Watershed Council in achieving its goal of ensuring a stronger, healthier watershed and community. To do this, we compile lessons learned from the Canadian Watershed Research Consortium (CWRC) (based on participation in a workshop led by the Canadian Water Network, CWN) and from the experiences of other regions in Ontario.

Terms

Adaptation	An adjustment in natural or human systems in response to actual or expected climatic stimuli (or their effects) ¹⁴ .
Integrated	<i>Monitoring</i> : a coordination of efforts between stakeholders using a comprehensive set of indicators. <i>Management</i> : multiple forms of knowledge, values and incentives from multiple stakeholders combined into a more effective management solutions.
Cumulative Effects	"Changes to the biophysical, social, economic, and cultural environments caused by the combination of past, present and 'reasonably foreseeable' future actions." ^{20, 21"}
Cumulative Effects Assessment & Monitoring (CEAM)	"The process of monitoring, tracking and predicting accumulating environmental change relative to established limits ⁵ (p.1)."

"Water is the most critical resource issue of our lifetime and our children's lifetime.
The health of our waters is the principal measure of how we live on the land."

~Luna Leopold, leading US geomorphologist and hydrologist, son of Aldo Leopold

Communication with – and education of –the community is key to implementing necessary programs or effecting behavioral change. Thus, we offer a brief review on current communication strategies used by the Muskoka Watershed Council (MWC), including a comparison to similar programs used in other regions.

1.1 Importance of Watershed Monitoring

Monitoring indicators of ecosystem health is important for creating and maintaining a resilient ecological community that is able to continue functioning in the face of ecological challenges, as it allows for the identification of early warnings and emerging challenges^{17, 24}. Russel, Wickson and Carew (2008, p.464) described ecological problems as “existing in an interconnected social and natural context and, as such, being complex, uncertain and lacking clearly defined boundaries.” Similarly, watershed management requires a need for a variety of disciplinary specialties, from hydrology to psychology. Since ecological problems emerge from multiple interactions of stressors (rather than easily identifiable, isolated factors), they require the involvement of various disciplines and a blend of their processes; this makes managing ecological problems complex, dynamic and hugely diverse¹².

Monitoring program data are valuable to understand the various natural cycles and exchanges – the movement of energy and matter (e.g. nutrients like carbon and phosphorous) within and between ecosystems³ – that occur between land, water and air. Also, monitoring data allows us to track trends and patterns in environmental conditions (and changes) over time. However, the data must be analyzed to assess changes and trends relative to triggers and thresholds⁵. This is to inform management and policy strategies, as information is only as useful as the actions that follow.

Though authorities in the Muskoka Watershed have taken action to improve monitoring, growing uncertainties continue to face the region as we look to the future. The consideration of climate interactions is a crucial piece to the region’s ability to plan and manage for our increasingly uncertain, potentially volatile and highly complex future.



Terms continued...

Trigger The point at which some action is required; the indication that some predefined course of action (response) is needed.

Threshold When thresholds are reached in an ecosystem, a stable state is replaced with another¹¹. In other words, a tipping point, or a limit outside of which the state of an organism or system

Resilience The ability of social, economic and natural systems to function in a healthy, or normal, way despite a disturbance²⁴.

Adaptive Resource Management (ARM): A multifaceted way to deal with environmental change and uncertainty by bringing a diverse set of stakeholders together to facilitate learning¹³.

Integrated Water Resources Management (IWRM) “A process that 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

1.2 Comparison of Known Approaches: Integrated Water Resources Management (IWRM) and Adaptive Resource Management (ARM)

There are two common approaches to watershed management in the literature^{18, 25}: Adaptive Resource Management (ARM), and Integrated Water Resources Management (IWRM). ARM is a multifaceted approach to address environmental change and uncertainty by bringing a diverse set of stakeholders together to facilitate learning through the integration of new knowledge^{13, 18}. It was designed to be iterative in order to deal with uncertainty, as it is meant to be both anticipatory and adaptive¹⁶. IWRM is “a process that promotes the coordinated development and management of water, land and related resources, in order to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems¹⁸.” Thus, ARM encourages collaboration and flexibility, while IWRM considers the larger system, not just the physical area of water. Increasing complexity and uncertainty have created a growing trend to combine both approaches^{7, 18}. The two approaches, when taken together, have been shown to offer the following theoretical benefits over other water management⁶:



1. Increase effectiveness by improved integration of social, ecological and hydrological systems;
2. Add legitimacy and improve stakeholder cooperation through participation and democratic decision making;
3. Incorporate expertise through different forms of knowledge as well as the promotion of social learning; and
4. Promote flexibility and adaptability through iterative learning, managing and experimentation.

We propose the use of a combined approach using both ARM and IWRM for adapting to climate change in the Muskoka watershed region. Specifically, adopting a cumulative effects assessment and monitoring program will allow a holistic process to track environmental changes over time as well as lead to opportunities to connect monitoring data to decision making and policy.

1.3 Cumulative Effects Assessment and Monitoring (CEAM)

Cumulative effects assessment and monitoring (CEAM) may be the key to achieving the Muskoka Watershed Council’s goals of a healthy, prepared community and watershed as we move towards a climate-uncertain world. Within the process of CEAM, iterative and adaptive components allow the watershed a chance to evolve and correct itself while also providing watershed stewards and managers with a way of detecting issues early – thus improving resilience of both human and non-human communities^{5, 15, 17}.

CEAM is appropriate for whole-watershed management as it has been shown to function best at the regional scale. It is easily integrated into other existing monitoring strategies with strong relationships that can be understood between the various programs and the data produced by them. Cumulative effects programs also typically involve the public and are highly relevant to decision making and political processes¹⁵. Whereas current monitoring focuses on one or a select few stressors in a limited timeframe and in a certain environmental context, CEAM encompasses past, present *and future* stressors (long-term timelines) and their relationships and synergies^{20, 21}.

2.0 THE MUSKOKA CONTEXT

In addition to various water management responsibilities from the government, the District Municipality of Muskoka, the Muskoka Watershed Council and Friends of the Muskoka Watershed all work together to ensure watershed health and sustainability. Within this collaboration, it is important to acknowledge that stakeholders have different priorities, powers, and timeframes (e.g. the business community may function in quarterly timeframes whereas a scientist may be using 50 years or more as a planning reference) associated with them depending on the scale and political jurisdictions of which they work.

Figure 1 illustrates a grouping of the more active stakeholders involved in the monitoring and/or decision-making process. Though each subgrouping represents theoretically similar interests, it is important to recognize the unique needs, interests, and capabilities each individual stakeholder has. There are a variety of diverse stakeholders, cross-sectoral and over multiple scales, who have an interest in the Muskoka Watershed.

If a holistic climate change adaptation strategy is to occur for Muskoka Watershed, all stakeholders need to be involved in the process (monitoring, consultation, decision-making, etc.) so as to develop ownership of the program resulting in higher levels of effectiveness and success.

2.1 Integrate monitoring: lessons from the Canadian Watershed Research Consortium (CWRC) and other regional adaptation case studies

CWN's CWRC aims to support regional efforts to design and implement watershed-level cumulative effects monitoring in order to provide

structured support for decision-making in land use management, natural resource management, impact mitigation and others. Through this effort, 6 watershed research nodes were created and followed a CEAM process based on their context specific needs. Lessons from this experience will be highlighted here, and contribute to the recommendations for the Muskoka region.

An initial barrier to success for Muskoka is the lack of an effective and efficient data management program. The need for better organizing and storing data collection between institutions will improve accessibility and transparency of data sets²². A more streamlined data management program will require continued buy-in and collaboration from stakeholders within the region, as well as achieving consensus on what to measure, how often, and how to ensure there is minimal overlap (excluding overlap done for validation or confirmation purposes). For Muskoka, perhaps the Ministry of Environment and Climate Change will be willing to administer and own the data for a new data program.

Another early step for making monitoring in Muskoka more efficient and comprehensive is to use the process for developing a CEAM program laid out by CWRC². Moving forward from the CWRC, Muskoka should develop a monitoring program (per the previous pages) and improve indicator models to strengthen the predictive capacity of CEAM². Additionally, it is important to identify which stakeholders in Muskoka are willing to take on administrative responsibilities, and determine how to adapt communication strategies.

These remain key questions that need to be answered prior to moving forward with developing and implementing a CEAM program as part of a Climate Change Adaptation strategy.



ADAPTATION CASE STUDY 1: The Lake Simcoe area was selected by Ontario's Expert Panel on Climate Change as a pilot project for potential province-wide adaptation policy and planning¹⁹. Some of the themes identified in the Lake Simcoe process include involving people, reducing threats, enhancing adaptive capacity and improving knowledge. Lessons learned from this process that can be applied more broadly to other contexts included the following:

- Involve stakeholders and experts early and substantively.
- Ensure appropriate expertise (capacity) is in place.
- Use a range of climate models and scenarios when possible.
- Enable completion of vulnerability analyses.
- Allow adequate time for community members to participate in climate change adaptation planning.
- Carefully select brainstorming strategies to match needs, expectations and time.
- Involve community members on an ongoing basis and in flexible ways that meet their diverse needs.

ADAPTATION CASE STUDY 2: In the Lake Superior area, projected changes and the effects of these changes were identified in their report, *Climate Change Impacts and Adaptation*¹. Some examples include: an increase in precipitation, zooplankton life cycles being affected (affecting the food chain) and warmer lake temperatures. Six climate adaptation action categories were presented¹:

- Manage non-climate stressors (i.e. invasive species, habitat degradation, etc.).
- Manage habitats, species and ecosystem functions. The goal here is to sustain native biodiversity, helping them cope with disturbances from climate change.
- Conserve and connect habitat (e.g. migration corridors).
- Enhance adaptive capacity.
- Increase knowledge (through monitoring).
- Provide public outreach and motivate action to adapt.

ADAPTATION IN MUSKOKA: The Muskoka Watershed Council (MWC) recently released its own document in preparation of addressing climate change, *Planning for Climate Change in Muskoka*²². While the majority of the report summarizes the science that came out of recent monitoring programs, the final few pages outline recommendations as follows:

1. Actions to improve understanding of the ecological functioning of the Muskoka environment:
 - a. **Strengthen and broaden the existing monitoring of lakes in Muskoka** [the first focus of this paper].
 - b. Develop new research program on causes and algal blooms in Muskoka Lakes.
 - c. Develop new research program on the effects of road salt on Muskoka aquatic systems.
 - d. Develop new research program on the combined effects of calcium decline and climate change on forest ecosystems in Muskoka.
 - e. Undertake a review of wetland ecosystem components valued by community members, and of active resource management techniques for retaining wetlands in the face of increasing summer/fall drought.
 2. Actions to address anticipated impacts of climate change on the Muskoka environment:
 - a. Plan and implement policies and infrastructure that will permit some capacity to control water flow through the Muskoka River watershed.
 - b. Undertake a review of planning documents to ensure that floodplains are appropriately delineated for the climate anticipated for mid- to late-century.
 - c. Regularly scheduled reviews, and planning for retrofit or expansion of any municipal infrastructure, should incorporate the latest information on local impacts of climate change.
 - d. Develop up-to-date information for landowners on methods for maintaining their forested land.
 3. Actions to prepare our built infrastructure and its management for the climate of mid-century:
 - a. Plan for added capacity for winter road maintenance under a higher precipitation winter climate.
 - b. Review adequacy and program replacement/upgrade of storm water handling infrastructure.
 - c. Review adequacy of fire prevention and fire-fighting capacity and implement a program for capacity improvement as required.
 - d. Encourage the construction of energy-neutral housing and other buildings in Muskoka.
 4. Action to facilitate the effective implementation of these recommendations:
 - a. **Every individual Muskokan should undertake to become informed on climate change issues, and take real steps to reduce his/her own carbon footprint** [the second focus of this paper - facilitating education through communication].
 - b. Establish the position of Director of Climate Adaptation within the District Municipality of Muskoka government.
 - c. Convene a Steering Committee to facilitate the collaborations needed, and to ensure implementation is on track.
- Though we have recognized an opportunity to strengthen current management and decision-making processes, the MWC report did not discuss reworking such systems. In the full version of this report we have provided a synthesis of some of the relevant literature and practices from other regions. A synthesis of the various management models and approaches is also included.

3.0 ADOPTING A REGIONAL CLIMATE STRATEGY: PROCESS, COMPONENTS, AND STRATEGIES

Below are brief descriptions of the recommendations discussed in the full report. Refer to the full report for more information on how we developed these concepts, and the literature they came from. Figure 2 in the end pages summarizes the entire process as described in the full report.

3.1 Component 1: Identify Monitoring Indicators

In order to make progress towards CEAM, monitoring organizations need to come to a consensus regarding which indicators are priorities for ongoing measurement and reporting, as well as how they will be studied (e.g. have a consistent methodology for each indicator that can be followed by successive researchers). This ensures comparability (inferring trends) between reporting years and also replicability of the data.

3.2 Component 2: Data Management

Needs identified for next steps in Muskoka were (1) a more effective monitoring program (discussed previously) and (2) a more accessible, transparent and centralized data management system (i.e. a common database). Benefits of a new data management system may include the minimization of monitoring costs and the reduction of effort duplication (i.e. unnecessary or redundant activities). It is unclear what entity in the Muskoka region would be responsible for covering the administrative costs and duties to merge or commence a shared data management program moving forwards. Other considerations include increase administrative costs, how to standardize data collection methods between monitoring programs increased transparency, and enhance continuity from successive researchers. Lastly, determining who will be accountable for implementing solutions and recommendations will need to be decided by the regional stakeholders. Still, if procedures are standardized and data compiled, comparisons and trends in monitoring data may be improved.

3.3 Improving Communication Strategies

As the sharing of knowledge is a key goal of the Muskoka Watershed, a brief evaluation of the Report Cards and the 2009 Progress Report are taken together. More detail is available in the full report, including a separate review of the Background Reports (not discussed here).

First, we look at what kind of trends can be inferred from the Muskoka Watershed Report Cards system. Information and data shared via background or other methods are not represented in this review, as it is likely in some cases that a member of the public may only read a single Report Card and nothing else. Community needs and realistic expectations should be considered when assessing the communication of information and its potential efficacy or usefulness to the public. Overall, few long-term trends (i.e. between successive Report Cards) were identifiable. This is partially due to availability in researchers and data, however the primary issue is the constantly changing organization of the measures in different categories by different names from one report card to another. When considered together there was not enough congruence or continuity in their expression of indicators, symbols and measurement units to infer temporal or spatial trends.



While the background reports demonstrated that much of the same information was collected each year (with some differing measures), this was not evident in the summarized reporting. Easily understood units that are consistent, and fewer indicators in both the report cards and the background reports, would make the information shared much more digestible to the general public. The background reports together make up 320 pages of somewhat-simplified scientific dissemination – likely overwhelming for the average layperson.

Recommendations from previous research on similar programs across Canada had concluded²³:

1. Issues discussed should be stakeholder-determined;
2. Measures and indicators should be consistent;
3. The number of indicators should be limited, and formats simple;
4. Measures should be temporally relevant, science-based and spatially-explicit;
5. Explain major cause-effect relationships;
6. View the report card process as a means by which to build support;
7. Incorporate marketing and outreach; and
8. Ensure performance measures to assess how effective the program is.

Overall, watershed report cards have a multi-purpose role as a tool for planning, assessment, involvement, learning, and research²³.

4.0 MAPPING A WAY FORWARD

There are several lessons and recommendations shared briefly here; refer to the full report for more detail. Effective climate change policy processes are iterative, and assessments should be multidimensional. Cumulative effects assessment and monitoring satisfies this to a large degree, though other actions such as vulnerability analyses^{8, 17} appear to be complementary and effective as decision support tools. Locally available tools and techniques should be used to their full advantage. For example, Ontario has extensive data for use in Ecological Land Classification (ELC) and Ontario Wetland Evaluation systems. These data can be used to develop highly relevant management strategies (under a larger coherent management umbrella) according to the type of environment that exists in each locality of the watershed.

Education of the community, through report cards and other programs, is an ongoing priority. In addition, the creation of a centrally managed data system is needed – the importance of which should not be sidelined or underestimated. This kind of data management increases transparency, improves access to data especially when there is a high turnover in research personnel, improves efficiency and increase the ability to infer trends from the data.

Overall: adaptation is key in management systems, resiliency is the primary goal in ecological systems and relevance to localities is important.

Acting on this summary report would mean a long-term commitment, but it could reduce vulnerabilities, improve collaboration and create a more resilient community and watershed. A revision of decision-making processes should be further explored to ensure a comprehensive, multifaceted approach. Achieved, these recommendations will build a stronger, healthier and more resilient community and watershed despite future climate uncertainties.

For more information, or to request a copy of the full report, please contact the authors as follows:

Elaine Ho, e23ho@uwaterloo.ca | Sondra Eger, seger@uwaterloo.ca | Simon Courtenay, scourten@uwaterloo.ca



Muskoka
WATERSHED COUNCIL



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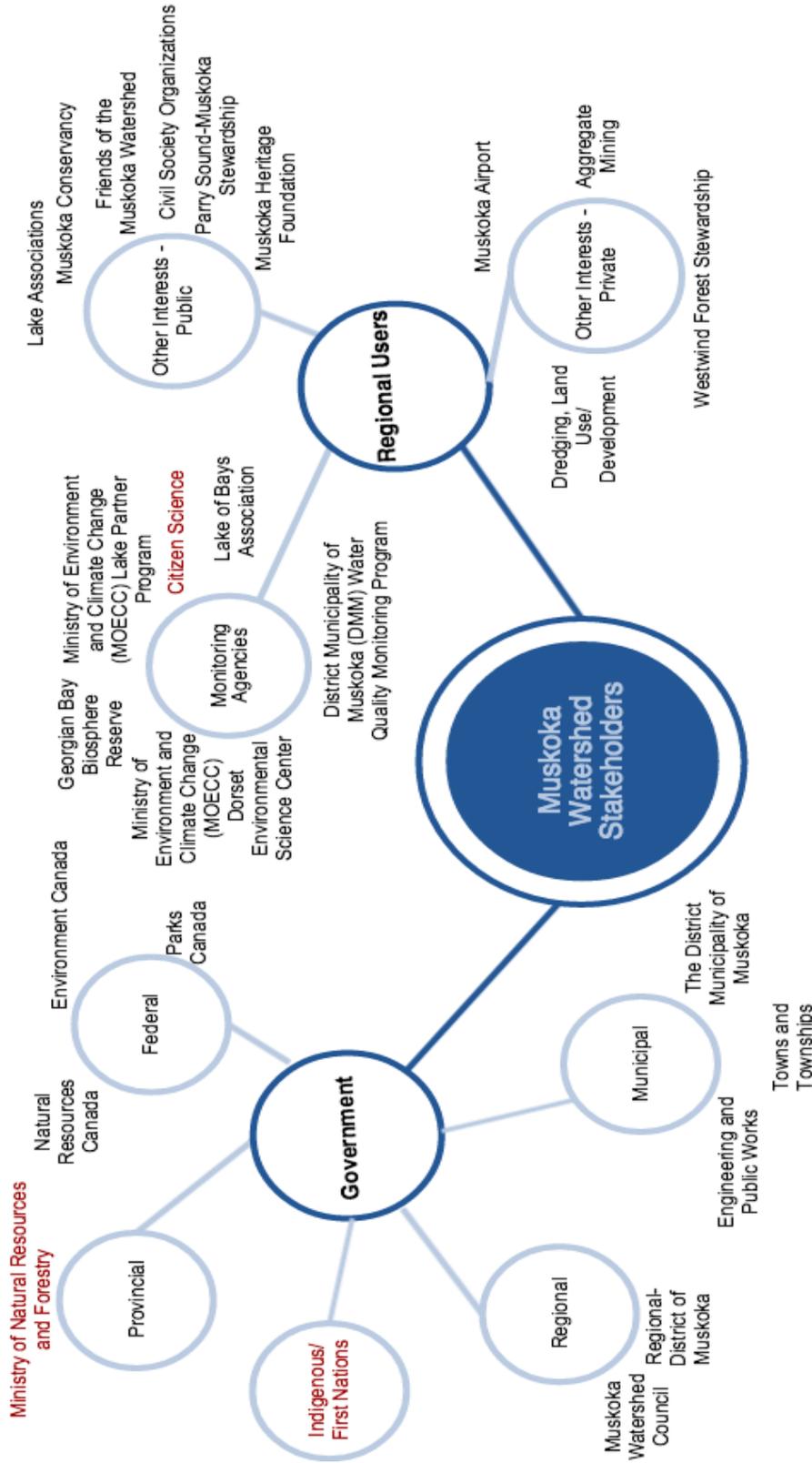


Figure 1: Stakeholder Map for the Muskoka Watershed. (RED: Need to increase involvement; BLACK: Currently involved).

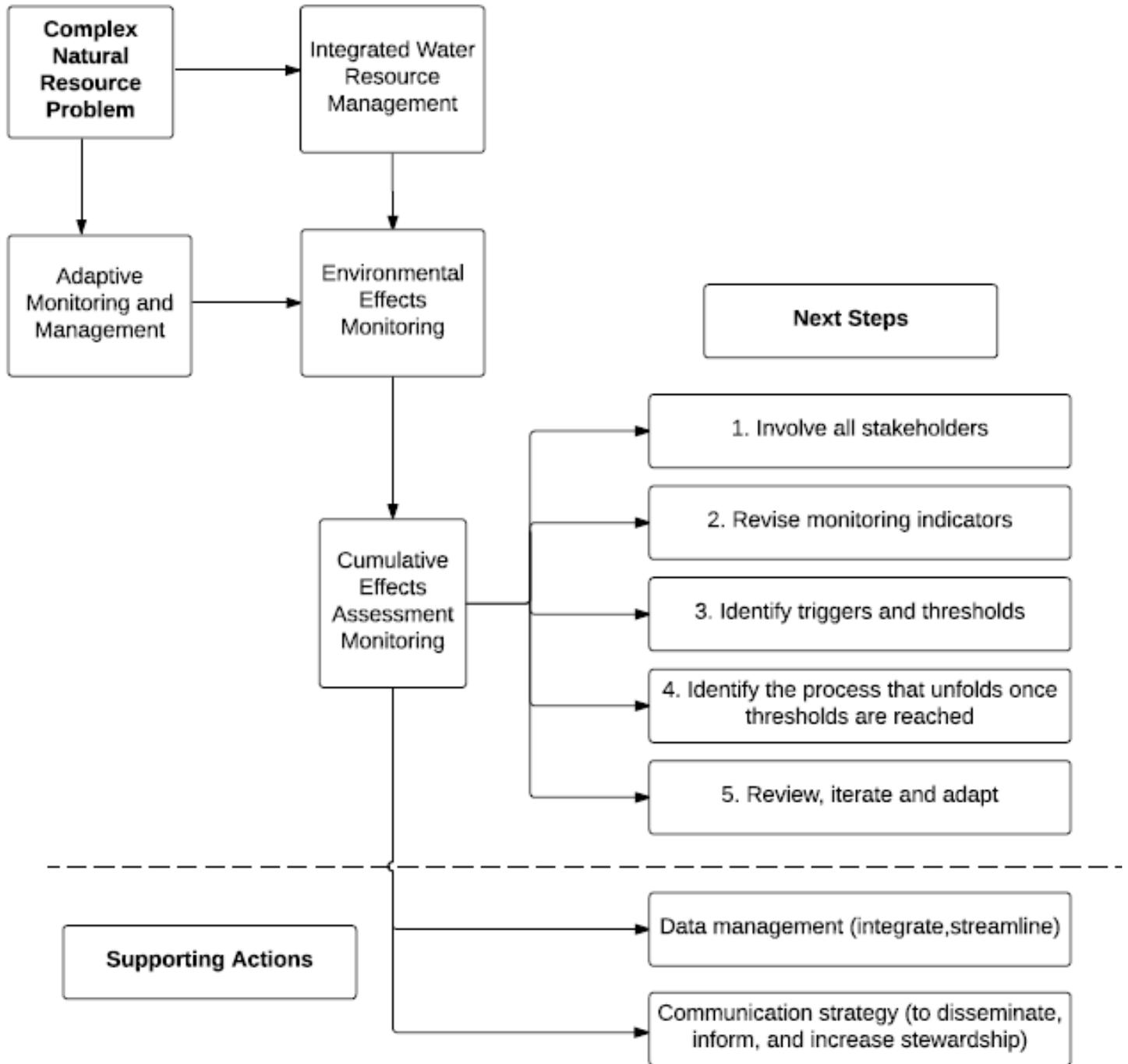


Figure 2. Proposed components to adopting climate-resilient watershed management practice, by way of CEAM.