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Developing knowledge on monitoring and evaluation of progress through analogues in the health and hydroelectricity sectors

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List of Acronyms (TBC)

AAC	Agriculture et Agroalimentaire Canada
ASSS	Agence de la santé et des services sociaux
CEAA	Canadian Environmental Assessment Act
CC	Climate change
CCA	Climate change adaptation
CMC	Community mobilisation committee
COMEX	Comité d'Evaluation/Evaluation Committee
CRÉ	Conférence régionale des élus
CSBE	Conseil de la santé et du bien-être
CSSS	Centre de santé et des services sociaux
DFO	Department of Fisheries and Oceans
DSP	Direction de la santé publique
ESIA	Environmental and social impact assessment
HQ	Hydro-Québec
INSPQ	Institut national de santé publique du Québec
JBNQA	James Bay and Northern Quebec Agreement
MAMROT	Ministère des affaires municipales, régions et occupation du territoire
MAPAQ	Ministère de l'agriculture, pêcheries et Alimentation
MDDEFP	Ministère du développement durable, environnement, faune et parcs
MRC	Municipalité régionale de comté
MSSS	Ministère de la santé et des services sociaux
MTQ	Ministère des transports du Québec
M&E	Monitoring and Evaluation
NRTEE	National Round Table on the economy and the environment
NRCan	Natural Resources Canada
REDD+	Reducing Emissions from Deforestation and forest degradation
RQLQ	Rhinoconjunctivitis quality of life questionnaire
SdV	Salaberry-de-Valleyfield
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
TQHP	Table québécoise sur l'herbe à poux
UKCIP	United Kingdom Climate Impact Program
UMQ	Union des municipalités du Québec

1. Introduction and Objective

Understanding the effectiveness of adaptation measures is critical to selecting and implementing interventions that best increase our capacity to adapt. Measuring progress on adaptation is an important tool for developing this knowledge, as well as serving other purposes such as accountability. In Canada there is limited experience in implementing concrete and specific adaptation strategies, and therefore also limited experience in measuring progress in this area. At a National Workshop organized by Ouranos in March 2012, one of the key recommendations was to learn from other areas with extended experience in monitoring and evaluation of programs. This project therefore describes two monitoring and evaluation (M&E) activities, one in the health sector and one in the hydropower sector, and to draw observations from these.

There is significant experience in the public health sector on which to draw. The selected health case study examines a pilot project for which monitoring and evaluation plan was established, in part, to identify whether a proposed strategy to reduce ragweed allergies in Salaberry de Valleyfield was effective, with a view to recommending its expansion across the Province. This learning focus is highly relevant to the area of adaptation, about which we know little in terms of effective strategies, and therefore where learning is an important objective.

We also document the adaptive management approach applied to the Eastmain 1A - Rupert diversion hydroelectric project. Accordingly, Hydro-Québec regularly revises the management of measures to minimise the impacts to a river system based on both quantitative biophysical data and qualitative information based on local traditional knowledge. This adaptive management approach is instructive insofar as adaptation to climate change is increasingly one that is seen to be iterative over time, and is as much a process as an outcome.

The objective of this project is to describe the M&E approaches through these two case studies and to draw observations and comparisons that may be insightful to monitoring and evaluation of adaptation to climate change. The following report is divided into two parts. Part A contains the core of the NRCan proposal to describe existing cases of monitoring and evaluation systems, including how they are developed and implemented. This section begins with a short description of some of the recent approaches to evaluation as described in the literature, and with this context describes and discusses the case studies. Part B then briefly reviews some of the lessons learned and observations which can be drawn for Monitoring and Evaluation (M & E) of adaptation initiatives, based on some of the known challenges in this domain.

PART A. Monitoring and Evaluation Methods and Case Studies

2. Background on Monitoring and Evaluation

An overarching objective of monitoring and evaluation includes strengthening current and future interventions. It is often described as a tool for iterative learning (UNDP, 2009; UKCIP, 2011). Monitoring and evaluation together form a tool often used for project and program management. It assists participants to follow the progress of activities, whether in terms of achieving targets related to timelines and financial disbursements; or, more complex targets related to the effectiveness of interventions in achieving given objectives. A common tool used to structure monitoring and evaluation systems is the logical framework, which will be well known to most government institutions. Tables 1 and 2 in section 3 provide abbreviated examples.

Concretely, monitoring is done on a continuous basis throughout the lifetime of an intervention through the identification, collection and analysis of data. Data can be qualitative or quantitative, new or existing and can be collected through any number of methods such as through questionnaires, field samples or reports by stakeholders. Monitoring of progress is most commonly undertaken by the proponents of an intervention itself as a means of staying on course. Evaluation of progress takes place in a moment in time and is often more analytical in nature, traditionally studying the planned outcome of a project (Arbour, 2011), such as increased adaptive capacity, and aims to inform future work based on improved understanding of a given problem and ways to address it.

2.1 Description of evaluation approaches

Arbour (2011) identified over twenty evaluation approaches and methods in the evaluation literature. In the last few years there has been a notable expansion to the role of evaluation towards not only studying the progress towards, or away from, an outcome or objective, but of using evaluation frameworks to investigate and understand the underlying problem which an intervention is seeking to address; in addition to identifying the changes required in an organization to achieve the delivery of a given program. Analytical tools for problem assessment can be used not only to analyse the results of an intervention after the fact, but also to inform the design at the earliest stages of a project (Arbour, 2011). This can be particularly useful in cases where the problem is not well understood, the solutions are undefined and therefore potential responses may be broad.

Given this, the "theory of change" is an evaluation approach espoused by a number of organizations dealing with such types of complex problems (GEF, UNEP, UKCIP). The application of this approach is recommended to evaluate the performance of interventions as well as to evaluate the logical flow of resources towards achieving a result – the causal chain or the logic model explaining the choice of intervention. The deployment of resources, whether they be human, financial, or political, are often planned based on an understanding of the effect that their application will have towards an objective. The causal chains/logic models seek to define this relationship.

The generic causal chain, illustrated in Figure 1 and developed in 2004 by the W.K. Kellogg Foundation, is the most commonly used logic model and underpins the theory of change. It structures the development of the flow of activities required to effect a desired change. The M&E plan is used to monitor these activities' progress and to evaluate the effect in achieving the desired change. From left to right, required inputs (1) (i.e. money and time required to put in place a measure) are identified to implement certain activities (2). These activities produce tangible outputs (3), for example, a draft revised policy. Up to this stage, inputs and outputs can be observed, counted, seen – the evidence of their achievement is fairly easily and directly measurable, and directly within the scope of a project.

The delivery of planned outcomes (4), such as increased capacity of an institution to manage climate change, results from the culmination of inputs, activities and outputs. Outcomes are often less immediately observable and can extend beyond the lifetime of a project and therefore are less easily and directly observable and measurable. Increased capacity for instance, cannot be directly measures. Rather, indicators are identified which suggest this capacity, such as an increased number of people who have been trained to use a given method, and a count of the number of times the new method is actually applied by those people.

Finally, impacts (5) define the ultimate reason for engaging in an intervention, such as reducing vulnerability to climate change. The challenges involved in assessing the achievements at each stage in the logic model increase significantly from left to right, but can also be more meaningful. Inputs, activities and outputs can be readily monitored over the course of a project, in so far as they are produced or completed. That these results lead to planned outcomes and impacts can be heavy with assumptions that should be understood and well defined. Much research effort is involved in improving our ability to measure towards the outcomes and impacts in order to know whether our activities are worthwhile.

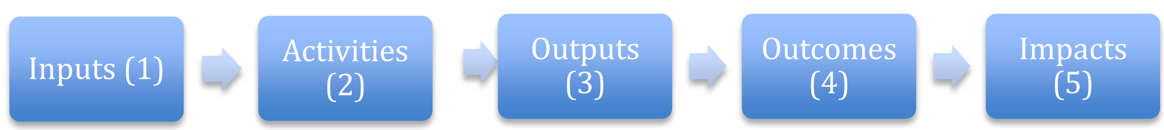

Figure 1. Generic Causal Chain

2.2 Indicators of the driving forces of change

The theory of change models are used to evaluate and define the causal chain or logic model as illustrated simply in Figure 1. As the name implies, it seeks to identify how and where resources can be directed to effect the desired change – the planned outcome or impact. Also, analyzing how and where within a system change takes place can help to identify indicators of positive or negative change. These indicators are often based on an understanding of what drives the achievement of a change, outcome, or result. By way of illustration, in the public health sector example that we will see in detail in the next section, the desired impact is improved quality of life in terms of health. This impact itself is not directly observable or measurable. However, factors that are known to contribute to this desired result include reduced symptoms of allergies, which can be measured using standard questionnaires. The assumption is that the reduced allergy symptoms improve quality of life, which is fairly subjective. Nevertheless, this measurement is usefully applied in a standardized and consistent and reproducible way, which does allow for identifying trends over time.

These components of the causal chain, accompanied by means to monitor and measure their achievement, form the evaluation framework that allows for assessing the effectiveness of an intervention (UKCIP, 2011). The theory of change traces the conditions needed to affect the desired objective by deconstructing that objective into realizable steps. This can take the form of a problem mapping exercise as well as mapping out the causal chains, tracing back from a desired outcome to needed outputs, activities and inputs needed to achieve a given outcome and impact (The World Resources Institute, 2011).

A challenge in structuring intervention logic, and measuring the effectiveness of those interventions, is to represent complex problems simply (Rogers, 2008) and to identify points in the logic model that can be observed and that represent real progress, or at least steps in the right direction. For outcomes that are difficult to observe, the drivers for the desired changes are often defined and monitored as a proxy indicator for the desired change. For example, an increased number of government financed projects that include climate change assessments can indicate an increased ability and capacity to respond to climate change. Normally, a number of different driving forces must exist for change to take place – a combination of factors that come together to result in a change.

2.3 Defining problems as Simple, Complicated or Complex

The way that a problem is understood and structured within the scope of a project determines the activities that will form part of an intervention. An ideally designed project is one that identifies and addresses the factors that are critical to achieving a result. Practically speaking, there are more often than not limitations to what one would like to do and what one can do, affected by issues such as resource availability, jurisdiction, knowledge and incentives. A selected number of causal chains are therefore selected and addressed within a project and are defined as simple, complicated or complex problems.

Simple problems are defined as having singular and linear cause and effect relationships. These problems have clear objectives for implementation and few variables affecting the achievement of the objective. An example could be increasing drainage size due to increased maximum rainfall. The risk of this approach can be an oversimplification of a problem, ignoring other factors that can have an influence on the success of a program (Rogers, 2008), such as reduced drainage system maintenance budgets or the impact of urban green space planning on water runoff.

Complicated problems are defined by several causal chains, either simultaneous or alternating, leading towards an outcome (Rogers, 2008). For example, reducing the effect of pollen on people sensitive to allergies may require simultaneously controlling the quality of pollen plants, providing people with information on managing their symptoms, and equipping clinics to detect and treat severe allergic reactions. Three separate causal chains work together to achieve the desired outcome.

Complex problems are defined by iterative causality relationships, positive and negative feedback loops and emerging and often unknown results. The relationships between cause and effect are many and are multidirectional. These systems often have critical thresholds or tipping points where the effects multiply with little additional effort (Rogers, 2008). Ocean acidification is an example of a complex system where increased ocean acidity can have multiple and multi-directional consequences, for example of biodiversity, on carbon sequestration, and on ocean circulation. Some modelling efforts attempt to apply mathematics and statistics to represent these systems in order to better understand them.

Within the scope of a given project, program or initiative, the problem at hand can be defined with any level chosen level of simplicity by those designing the intervention, or imposed on them by outside constraints. In some cases, it is also a reflection of the expertise forming part of the project team.

Defining and evaluating a problem too simply and linearly can result in missing out on critical driving forces that effect your desired outcomes. As the hydropower project illustrates in the next section, the added input of traditional knowledge to the management of the biophysical environment greatly improved the effectiveness of the decisions made to minimise negative impacts on the environment.

On the other hand, it is also too costly and often infeasible to define and manage an intervention that is too complex. A balance between simple and comprehensive enough is ideal, and is at the core of developing effective and efficient interventions. The evaluation of the efficiency of interventions in terms of economic justifications can be supported by economic analyses, but this is often not done, particularly with projects where continued activities or replication is not foreseen and so additional analysis is not seen as useful.

The following two analogue studies illustrate some of the issues described above in concrete examples, describing the evaluation approaches used and the lessons learned along the way. The first analogue is a pilot project in the health sector and the second analogue describes how monitoring and evaluation is used for adaptive management in the Hydroelectricity sector.

3. Analogue Studies: Monitoring and Evaluation Systems

3.1 Ragweed prevention policy: Ragweed 2007-2010, Salaberry-de-Valleyfield (SdV)

3.1.1 Background

The prevalence of the allergic rhinitis in Quebec is approximately 17% of the population and pollen is the principle cause (Héguy and al., 2009). An initiative was carried out over four years in order to reduce the presence of pollen producing ragweed plants in the région of Salaberry-de-Valleyfield (SdV) where the effects of ragweed constitutes a major public health concern. Salaberry-de-Valleyfield is located south-west of Montreal, in the administrative area of Montérégie (see no.1 in Figure 2).

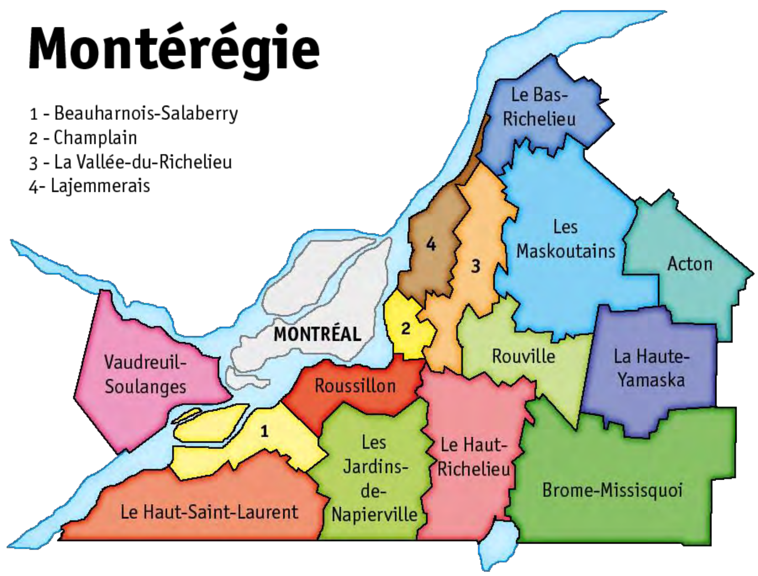

Figure 2. Map of Montérégie (Note: Champlain should be replaced by Longueil)

Thus, from 2007 to 2010, a pilot project was put in place and evaluated for its effectiveness in managing the incidence of rhinitis. The project was led by the Direction de la santé publique (DSP) de l'Agence de la santé et des services sociaux (ASSS) de la Montérégie et Agriculture et Agroalimentaire Canada (AAC), and supported by the Table québécoise sur l'herbe à poux (TQHP) and the municipality of SdV. The project implementation rested on collective stakeholder participation including the local population, the mayor of SdV, business owners, industries, and a number of different Ministries.

3.1.2 Health Pilot Project Objectives

The objective of the pilot project was to evaluate if multi-sectoral community mobilisation activities to manage ragweed would increase the quality of life of people affected by ragweed allergies.

To assess the effect of the activities and interventions put in place, an experimental site and a control site were studied (INSPQ, 2013). The project sites were monitored and results evaluated so that adjustments to activities could be made at the end of each allergy season if needed. As described in section two of this report, monitoring consists of collecting information consistently for pre-determined metrics, defined by an indicator. For example, collecting data on pollen concentrations. The evaluation aspect of the Monitoring and Evaluation (M&E) system is the assessment and study of that data. A common result is an identification of a positive or negative trend, such as a reduction in pollen concentrations. Ideally, and as was the case in the projects in this study, the evaluation of the data results in adjustments and revisions in practices and future decisions, also referred to as adaptive management.

The next section describes the monitoring and evaluation system that was put in place for this pilot project

3.1.3 Project Structure and Logic from a Monitoring and Evaluation Perspective

The project was implemented in the municipality of SdV, and the nearby city of Saint-Jean-sur-Richelieu (no 3 in Fig.2) was identified as a control site. The structure of the project logic is described in this section and is followed by a more detailed description of the indicators, and of their monitoring and evaluation.

The project included three components, each of which were monitored and evaluated:

- Firstly, a **community mobilisation component was** deployed to control ragweed. The researchers were interested in studying whether mobilising members of the community to undertake ragweed control measures would be an effective way to manage the problem. Alternatives could have been to hire a management firm or government employees for these activities. The daily activities such as number of field interventions by the different sectors were assessed through this component.
- The immediate effects of these measures to reduce the allergen itself was assessed through the **environmental management component**. This assessment determined if the measures put in place through community mobilisation resulted in a reduction in ragweed plants as well as a consequent reducing of pollen concentrations from local sources. Ragweed populations and pollen concentrations were monitored regularly throughout the project.
- Lastly, a **health component** determined if the community mobilisation resulted in reduced pollen allergy symptoms and improved the quality of life of local populations, measured through a quality of life questionnaire.

Figure three below illustrates the cause and effect logic described above that formed the basis of the project design.

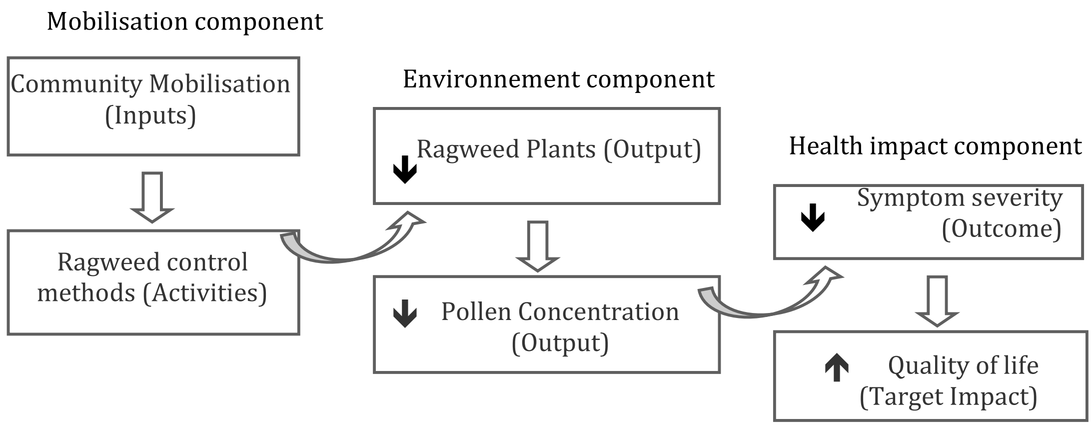

Figure 3. Causal chain and problem structure for SdV project (Source: project proposal: "Presentation générale du projet de demonstration, Evaluation de l'efficacité de mobilisation pour la lute contre l'herbe a poux sur la qualité de vie des personnes allergiques")

3.1.4 The indicators, process and means of measurement

Table 1 below summarized the monitoring system that was established to follow the project activities and results during its implementation, and which served as the basis for evaluating the overall results in terms of achieving the target impact identified – improved quality of life. This table includes the project intervention logic, indicators, means of verification, frequency of collection, responsibility for collection and analysis and risks. This table was developed through this study in order to explain the activities through a typical M&E management tool.

Three teams were established for each of the three components to regularly self-monitor the progress being made in the project activities and outcomes. **The three project components were monitored by three teams** for each of the community mobilisation, environment and health components. The data monitored for each component was evaluated at the end of each summer allergy season. This was done together by the three teams sharing the results from each component and making adjustments to the project activities and strategies as needed in order to maintain progress and take corrective actions when needed. These lessons were integrated into activities for the next allergy season – this formed the evaluation process and demonstrates the contribution of M&E to adaptive management approaches.

The evaluation exercise then as conducted by the three teams working together. This was an important aspect of the process in order to establish causal relationships. For example, to be able to identify whether the improvements in quality of life (health component) was a result of actual reductions in pollen concentrations (environment component), resulting from reductions in local ragweed populations (environment component) and finally as a result of community interventions (mobilisation component). This allowed the Departement de la Santé Publique in the region to evaluate whether community mobilisation was an effective way to manage the spread of ragweed allergies. Evaluation is conducted by analysing the data collected through monitoring.

Monitoring of the Community Mobilisation Component:

The framework guiding the operational activities of the community mobilization component is illustrated in Annex A. The operational activities for 2008 – 2010 were; 1) the identification of the overall and specific objectives for community mobilization, 2) the identification of activities to be undertaken by each of the sectors involved in the project as well as identifying their targets, and 3) the implementation of theses activities to control the ragweed plant proliferation depending on the given specific objectives and targets. These were monitored iteratively over the course of the project to ensure that the ultimate target impact of the project, improved quality of life, were being achieved through the project activities.

With respect to the community mobilisation component, three project partners were involved in the M&E of interventions: the municipality of SdV, the Centre de santé et de services sociaux (CSSS) du Suroît and the CRIVERT-Groupe écologique. The M&E of the mobilisation component took place only in the experimental area of SdV where the interventions took place. Two aspects were monitored using specific indicators selected to measure results and processes:

1. The establishment of a community mobilization committee (CMC) formed by project partners including the ASSS of Montérégie, la DSP de la Montérégie, le Canadien National (CN), le CSSS du Suroît, la Commission scolaire de la Vallée-des-Tisserands, Crivert, and Hydro Québec (HQ), etc.[1]
2. The implementation of a triannual plan to coordinate ragweed management activities in seven targeted sectors where ragweed plants can grow, including in transportation corridors, agricultural areas, commercial, industrial, institutional, municipal and residential areas. The evaluation of the activities was based on an analysis of the expected results from a successful and coordinated implementation of ragweed management plans.

Monitoring of the environment component

In terms of environmental monitoring, a first set of data (density of plants and pollen concentrations), were collected in 2007 (T_0) in the experimental and control sites in order to establish the baseline. Following this, pollen concentrations were measured each year in each project site. Ragweeed plant density was measured daily in the experimental site but only at the end of the project (T_3) in the control site. Ragweed concentrations (number of plants/m^2) were measured in different habitats engaged in the project, such as residential, natural and industrial areas, using a grid stratifying the region into segments of 1.5km^2. Pollen concentrations (number of pollen grains/m^3) were determined by counting the number of grains in a laboratory from daily sample during August. This was the responsibility of the municipality and of Agriculture and Agroalimentaire Canada.

Monitoring of the health component

The health component involved an initial group of 219 adults in the experimental site who were allergic to ragweed pollen. These people were selected based on their residence being in an area where intensive ragweed management was taking place. This group was compared to a control group of 220 adults suffering from the same allergy but residing in areas of the control site city with minimal ragweed management interventions. The groups were monitored using quality of life

[1] Suite des partenaires : le MAPAQ – Direction régionale Montérégie-secteur ouest, le MTQ– Direction de l'Ouest-de-la-Montérégie, MRC Beauharnois-Salaberry, Recycor Caoutchouc inc., Familiprix, Syndicat de base de l'Union des producteurs agricoles (UPA) de Saint-Louis-de-Gonzague, Ville de SdV.

indicators, using the standardized rhinoconjunctivitis quality of life questionnaire (RQLQ) questionnaire, as well as influence variables. The influence variables are those which could have an effect on allergy symptoms but are not related to the project intervention not to ragweed. For example, having housepets can influence allergy symptoms and can confuse the results of the study of the effectiveness of the project if not adjusted for. Using the questionnaires, this data was collected annually from 2007 to 2010 inclusively (T_0, T_1, T_2 et T_3) over the same one week period when pollen concentrations are typically at their highest.

A total of 440 people with ragweed allergies were monitored by the XXXX under the health component over the course of the project, including 220 people in each of the project and control sites, who were subsequently compared. The impact of the allergy on quality of life was measured using the *Rhinoconjunctivitis quality of life questionnaire* (RQLQ). Other variables that could influence the results, such as the presence of other allergies, medications, animals in the home, etc. were also monitored by the Departement de la Santé Publique (DSP) under this component to control for their effects.

A summary of the indicators established to monitor different components of the project are summarized in Table 1.

Table 1. Derived monitoring and evaluation system for the analogue study "ragweed prevention policy: ragweed 2007-2010, Salaberry-de-Valleyfield (SdV)

Project Component	Variables/Selected indicators	Means of Verification/Data source	Frequency of collection	Responsibility	Risks (Influence Variables)
Target Impact					
Increased quality of life	Quality of life scored on a global score on a scale of 7	Quality of life questionnaire (RQLQ)	Measured at the beginning of the project to establish the baseline and then annually	DSP de la Montérégie	Health factors: Other allergies Taking medication Pets at home, collected through RQLQ Meteorological data collected from existing databases SMC and MDDEFP Atmospheric pollution and smog data from EC and MDDEFP
Outcomes					
Health Component: Reduced severity of allergic symptoms	Measure of severity of symptoms scored on a scale of 7 as part of the RQLQ	Quality of life questionnaire (RQLQ)	Measured at the beginning of the project to establish baseline and then daily	DSP de la Montérégie	
Outputs					
Environmental Component: 1. Reduced plant density 2. Reduced concentration of pollen	1. Number of plants/m^2 2. Number of grains of pollen/m^3	1. Field count inventory 2. 15 Rotorod Sensors in each site	Measure at the beginning of the project to establish the baseline and then daily	Municipality of SdV and AAC	
Activities					
Ragweed management is target areas by different sectors: transport routes, agriculture, commercial, industrial, municipal and residential sectors	An inventory of ragweed management measures implemented by different stakeholders, including location, date of ragweed control intervention	Observations by participants and semi-structured interviews with stakeholders	Annually	Community mobilisation committee	

3.1.5 Conclusion

The evaluation of the interventions showed a positive outcome for the health, environment and community mobilization components. In terms of community mobilization component, collective efforts included the participation of dozens of local partners who implemented the triannual plan for ragweed plant management in the experimental area. Management adjustments were required during the project which also took place. These included changes to the implication of certain project partners, and in increasing the involvement of students in the field in order to be able to meet the established target impact.

With respect to the environment component, a significant drop in the number of ragweed plants was observed in the residential areas (3 *vs* 1 plants/m^2), industrial (11 *vs* 4 plants/m^2) and disturbed (20 *vs* 7 plants/m^2). In the same areas, the concentration of pollen, measured in grains per cubic metre of air, at T_3 showed a reduction from 235 to 101; 312 to 192; and 823 to 447, respectively.

In terms of the health component, the project showed a reduction in the severity of allergic symptoms, as well as an improvement in the quality of life in the communities where the project interventions took place.

The results in terms of increasingly quality of life were evidently successful. However, in terms of affecting public policy and program expansion, a determination of the cost effectiveness of the program was needed. As a separate initiative, a subsequently study in 2013 by l'INSPQ undertook a cost benefit analysis to determine if the program could be defended in terms of public spending, and concluded positively in favour of the strategy (INSPQ, 2013). This was undertaken separately from the formal monitoring and evaluation system established as an adaptive management tool during the project and was used instead as a post project evaluation to advise decision makers.

3.2. Eastmain-1-A and Rupert Diversion Project: Adaptive Management of the ecological instream flow to the lower reaches of the Rupert River

3.2.1 Context: Environmental and Social Impact Assessment

Hydro-Quebec began the construction of the Eastmain-1-A and Rupert Diversion Project, located in the James Bay Territory of Quebec (see Figure 4 below), in 2007. The project includes a number of different components: (i) the Rupert diversion, which consists of redirecting some of the waters from the Rupert River watershed into the Eastmain watershed; (ii) the construction of an additional generating station (Eastmain-1-A) on Eastmain 1 reservoir; (iii) four dams, (iv) ~ 50 dikes; (v) two diversion bays with a total area of some 395 km^2; a tunnel between the two diversion bays; (vi) a network of canals to direct the flow into the various parts of the diversion bays; and (vii) structures to restore instream flow to the lower reaches of the Rupert River as well as Lemare and Nemiscau rivers.

The Eastmain-1-A and Rupert Diversion Project was subject to two impact assessment and review processes: the provincial environmental and social protection regime under the *James Bay and Northern Quebec Agreement* (JBNQA)[2] and the *Canadian Environmental Assessment Act* (CEAA)[3]. Based on the impact assessments, a review panel approved the project. A total of 22 recommendations were directed to Department of Fisheries and Oceans Canada and 11 were directed to Transport Canada regulatory areas of responsibility. As well, the Panel directed 2 recommendations to the federal government in general, 47 recommendations to Hydro Quebec and 1 to Cree authorities.

Specific recommendations resulting from the environmental and social impact assessment (ESIA) were made with respect to fish and fish habitat, navigation, mercury and public health, traditional land use, and adaptive management. With respect to ecological instream flow of the Rupert river an adaptive management approach was applied to address modifications and imprecision that may arise during the construction and operation of the project, due to its complexity (see footnote 3 and 4 for reference).

Hydro-Québec therefore established a monitoring and evaluation plan, a follow-up program extending from 2007 to 2023 as well as an instream flow and an adaptive management process to ensure inflows to the lower reaches of the Rupert River in order to maintain the ecological balance of the river system and to minimize impacts on the environment. In addition, concerns were expressed during the ESIA by residents of the Cree communities regarding their loss of traplines and areas traditionally used by the communities.

An adaptive management approach was applied to the M&E of the project in general, but specifically to the establishment and management of the minimum instream flow to ensure hydrological and ecological functions of the river. An innovative aspect of this exercise has been the incorporation of social factors, described later in the text, during each phase of the project. This analogue study examines the process established to identify the environmental target for maintaining a healthy ecological river function as well as the adaptive management approach applied to do so.

[2] http://www.mddefp.gouv.qc.ca/evaluations/eastmain-rupert/rapport-comexfr/index.htm
[3] http://www.dfo-mpo.gc.ca/reports-rapports/eastmain/eastmain-eng.htm

Figure 4. Map of Eastmain 1-A and Rupert Division

3.2.2 Description of the Analogue: Maintaining an ecological instream flow on the lower Rupert river

This analogue study focuses on the component of the project related to the derivation of the Rupert River for hydroelectricity production, and the adaptive management of the effects downstream from the derivation, based on maintaining an ecological instream flow. Ecological instream flow, expressed as a percentage of average annual natural flow, which is the minimum water flow required for hydraulic works, such as a hydroelectric operation, and for maintaining a healthy river ecology on the lower Rupert river.

This analogue looks at the establishment of the environmental objective of ensuring inflows to the lower Rupert river sufficient to maintain fish populations at the existing and improved levels as compared to their initial baseline levels as measured at the outset of the project in 2007 (T_0), for which detailed monitoring plans were a recommendation of the Panel. Also, the analogue study demonstrates how monitoring and evaluation systems can be used towards adaptive management practices through the incorporation of traditional knowledge into the environmental monitoring system as a whole. The latter was achieved through active participation by the representatives of the Cree communities in the verification of the minimum required instream flow.

The objective of the monitoring and evaluation program established was to ensure environmental protection during the construction and operation of the derivation project. This followed from specific recommendations that were made by the panel review of the environmental and social impact assessment that was undertaken, as mandated by Canadian law. The next sections discuss, firstly, the methodology for establishing the ecological objective and, next, the adaptive management approach that was applied to ensure that it was achieved.

3.2.3 Establishment of the Environmental Objective and Monitoring: The ecological instream flow

The objectives of the environmental monitoring and evaluation program established were:

- To monitor and verify the scale of environmental impacts as identified during the evaluation
- To evaluate the efficiency of mitigation measures put in place, and, to identify and put in place corrective measures as needed
- To develop improved methods for assessing and predicting potential impacts for integration

In the context of the partial derivation of the Rupert River, the main variables used for establishing environmental objectives and subsequent monitoring are focussed on fish populations and their habitat.

Two years before the beginning of the project, twenty-one species of fish were monitored, and the data collected were used as input to create a computerised model the river's ecology and in particular of the fish habitat. A model is useful to test the impacts of different management strategies of the derivation area on the fish population and river ecology in general. Other variables were also inputted into the model such as geomorphology, temperature, oxygen contents, etc. The objective was to understand the functioning of the river system in order to maintain its functioning during the construction of the derivation and during its operation.

During the two periods of the year important in the fish life cycle, autumn and spring, detailed modelling of the fish habitats was undertaken of the required river flow was calculated in order to ensure adequate water supply during fish spawning times of the year. During the other seasons, winter and summer, the model was used to analyse the impact of the river ecology of maintaining 20% of the average annual natural flow to the lower parts of the river from the point of the derivation. This figure was established through an agreement between the Cree National and the Government of Québec.

Once the ecological modelling complete, five key fish species were selected to be monitored during the spring and fall for the duration of the project construction and operation. These were selected based on a number of criteria including sensitivity to river flow changes, their socio-economic and their biological importance. Selecting five key indicator species avoids the need to monitor all twenty-one species that can be found in the area.

Developing specialised models, as was done in this case, is useful for predicting the quality and quantity of fish habitat available under different water flow scenarios. This is especially important for simulating, for example, the effects on the river and fish of severe drought, a worst-case scenario. A number of computer simulations were run to identify the effects of different water levels, scenarios, on each of the twenty-one species in two different locations on the lower reaches of the river, downstream from the derivation. A target ecological instream flow downstream of the derivation of 20% of the average annual natural flow was thus confirmed as a safe quantity in terms of protecting the natural river ecology.

Following the identification of the target of 20%, biological indicators of the spawning habitats for the selected five species were monitored for five years in order to ensure that the selected 20% target was indeed sufficient to protect the fish and their spawning grounds. The abundance of larvae is a key indicator overall. Also, during wintertime, the availability of water to spawning grounds was monitored while during the summer, the fish growth stage, indicators included the abundance of juvenile fish, the abundance of the 21 key species in the river and the fish catch quantities over a given time duration.

Table 2. Environmental monitoring for the ecological instream flow

Target Impacts	**Example Selected Indicators**	**Means of verification**	**Frequency of data collection**
To ensure the effectiveness of the instream flow to maintain fish populations in a similar or better state compared to the initial base time (T_0)	- Larval drift - Spawning success of target species -Abundance and diversity	Quantitative biophysical data collection studies	Baseline established 2 years before the beginning of the project, then by the end of each season

3.2.4 Integrating social dimensions and adaptive management

As illustrated in Figure 5, the monitoring and evaluation program integrates traditional knowledge in order to improve and adjust the management of environmental risk mitigation measures. This has helped adjust environmental management measures to improve their effectiveness from an environmental and social perspective and took place at each stage of the project.

The three methods used to collect information on traditional knowledge were through direct interviews or meetings with land users, through informal exchanges with hunters and workers during field visits, and through workshops designed to document information from Cree populations.

This information was used to adjust management decisions. Some examples of this from the 2009 monitoring and evaluation report include: obtaining additional information about the behaviour of sturgeon during spawning and the spawning timing, information on the main fishing grounds frequented on the Rupert, Broadback, Nottaway and Pontax rivers (Cree traditional knowledge has influenced the choice of the Nottaway River as control site for monitoring purposes); and to better distinguish the furrows left by the ice of those left by beavers and muskrats. (Hydro-Québec, Bilan 2011).

Collecting qualitative data from Cree populations as such served as input into factors such as choices for locating ponds and hunting areas; siting of two wetlands converted into peat bogs; validation of the activity status of beaver huts identified during land surveys; choice of water bodies to be inoculated with young sturgeons produced in the hatchery in 2009.

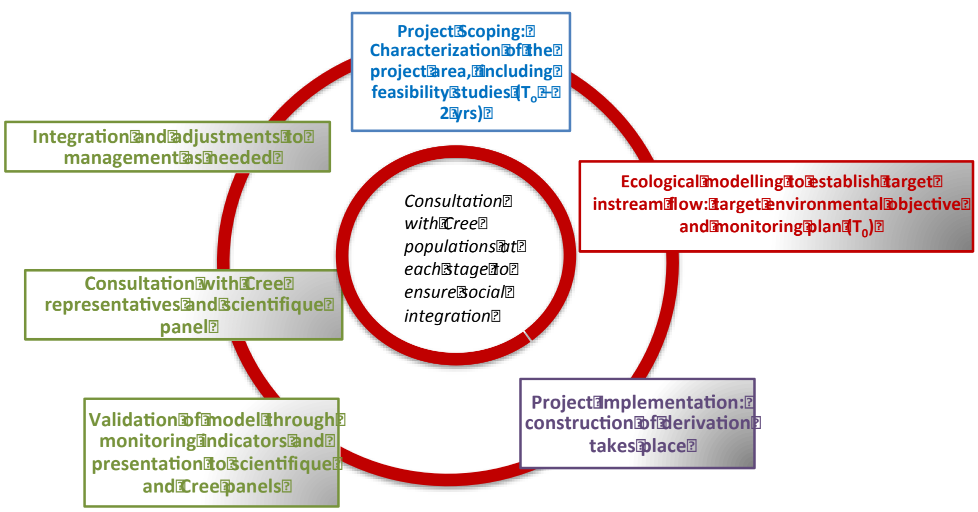

Figure 5. Adaptive Management and Integration of Social Dimesnsions

3.2.5 Reporting

In 2010, the field validation and verification of the post river derivation fish population and fish habitat was conducted. The environmental impacts of the Eastmain-Rupert project proved to be acceptable insofar as they have been limited by the implementation of effective mitigation and compensation measures, measures based on a rigorous scientific basis that also integrate Cree traditional knowledge, and on the basis of a series of observations and objective measurements as part of a rigorous monitoring program. The commitments by the proponent with respect to adaptive management also facilitated the social acceptability of the project, among other things creating communication channels where the concerns of users regarding the impacts of the project were heard.

In the legislative and multi-jurisdictional context of this project, and its size and potential consequences, a structure has been established to ensure the implementation of monitoring plans and to review and evaluate the results.

A standing committee between the government of Québec and the Cree authorities, the Examination Committee (COMEX[4]), was established to receive the results of the environmental and social impact assessment, to analyse the project and can request additional studies and verifications on the part of the project proponents, in this case Hydro-Quebec. The COMEX can also conduct public consultations with affected communities. The COMEX did indeed undertake public consultations with the Cree populations to verify their perceptions on the effectiveness of risk management measures put in place (Hydro-Québec, Bilan 2011). Finally, the committee has a mandate to recommend the project for approval and to make additional recommendations to the proponent given the results of the assessments and consultations.

In the specific case of the Eastmain 1-A project, the COMEX mandate was activated, but in addition, the federal government appointed experts to the committee to form a special joint panel between the COMEX and the federal government. The COMEX Eastmain Panel produced a report recommending the project with a number of conditions, called recommendations to Hydro-Québec. Because of this expanded federal representation on the COMEX, the panel also prepared a set of recommendations to the Department of Fisheries and Oceans (DFO), Transport Canada (TC), the Cree authorities and Hydro-Québec.

The day-to-day implementation of the recommendations for monitoring environmental and social consequences is overseen by an analyst appointed in the Ministère de Developpement Durable, Environement, Faunes et Parcs (MDDEFP), based on monitoring reports prepared by Hydro-Quebec. The report is verifies by the MDDEFP who then reports the results to the COMEX.

At the Federal level, each Ministry is responsible for ensuring the implementation of those recommendations that it received from the Panel. Finally, the Cree authorities formed a Cree monitoring committee, who receive and transmits information regularly to affected communities (from personal communications with the MDDEFP).

3.2.6 Conclusion

[4] http://www.mddefp.gouv.qc.ca/evaluations/eastmain-rupert/rapport-comexfr/index.htm

In 2010, a post river derivation validation of the ecological models was undertaken. At the same time, a major drought affected Quebec, and quantities of water over and above the natural flow of the river were released from the derivation point to the lower reaches of the Rupert River. This event highlighted a gap in the existing monitoring system of ecological health of the river – that of the perception of the local Cree communities in terms of the management of the ecological instream flow and it's appropriateness. The needs of local affected populations, in particular related to their traditional hunting and fishing practices had been affected by the derivation. Adjustments therefore were made to the monitoring and evaluation system and to the adaptive managements of the instream flow, such as the establishment of additional spawning grounds for fish stocks. In this way, qualitative data were incorporated into the monitoring and related management of the project area.

The project re-enforced the importance of integrating social indicators and information at the earliest stages of project scoping and objective setting, as these influence the design of monitoring and evaluation systems. Local knowledge, qualitative assessments and expertise in social parameters affecting a project area or institution are important for increasing acceptance of a project and its appropriateness. In the context where a system is experiencing constant changes, such as was the case in this derivation project and is also the case with climate change, an iterative learning process, supported by M&E, is essential for achieving target objectives.

4. Discussion of the two analogue studies

The analogue studies allow us to observe five important aspects of M&E systems and evaluation theory: objectives of the M&E systems, adaptive management, establishment of attribution controls, and problem structuring around the theory of change.

Objectives of the M&E System

It is fairly significant that the two projects fell out of very different objectives: learning and demonstration is the case of the health project, which was a pilot project to test the effectiveness of an approach to ragweed management; and in the case of the hydropower project, which sought to mitigate identified potential negative impacts from the construction and operation of the site. The objectives were very specific and were an important risk management tool. The entry point for M&E therefore directs what will be measured, how, who will be using the data and the time period over which it is collected.

Moreover, the exercise of evaluating a problem, and identifying cause and effect relationships that form the M&E system, is in itself a useful project design tool. The objectives of the project and the objectives and indicators of the M&E system are most useful when developed together. This means that the M&E system, including indicators would already be identified at the stage of project initiation. In many cases, resources are required to first develop baseline data, and so this can be one of the first activities undertaken once a project is initiated and resources are unlocked.

Adaptive management

Both projects took a flexible approach from the outset of their activities and identified an adaptive management philosophy. This was implemented using three techniques: i. collecting, sharing and assessing monitoring data on a regular basis against an established and agreed schedule; ii. allowing for flexibility in the decisions that were to be made in the future based on these observations and; iii. Combining quantitative and qualitative data to validate and adjust decisions.

Monitoring of biophysical variables was easily done in a comprehensive manner using established techniques and technologies. Social data was collected using questionnaires, informal meetings and site visits and workshops. Some sectors have longer experience in collecting this type of information, such as the standardized questionnaire used in the health sector. Natural resource managers may have less access to such types of techniques. Projects teams can generally benefit from having a mix of expertise from the biophysical and social areas. This is clearly an important component to adaptive management capacity whether within a project or organization.

Establishment of attribution controls

Both projects had established control sites where impact data was collected but where there were no measures implemented in order to increase confidence in the effects of the project strategies. In addition, the health sector project identified and monitored variables which could influence the results but were not directly related to the project intervention, called influence variables here. This is an important aspect to learning about the effectiveness of given measures in order to identify which ones to maintain. It allows for adjusting results for influence from other non-related contributions to the results. It can also be an important means of identifying potential negative impacts or unintended consequences of a project. Using a climate change adaptation example, one may want to measure the effects of coastal rehabilitation in reducing the vulnerability of fisheries to the impacts of climate change. Factors unrelated to the coastal works may influence this, such as population shrinking, and could be measured as an influence variable.

For instance, the hydro-sector project had effects on the traditional hunting and fishing habits of the Cree populations, which would not necessarily have been foreseen by water and energy resource managers but is an important impact of the project. A broad based scoping of the cause and effect relationships, and broad level consultations, at the outset of a project can help to identify these influence variables as well as potential unplanned negative consequences of a project strategy which need to be monitored.

In the case of the health sector, the project proponents recognized other influence factors that can have significant effects on allergies in the population, such as taking medication or the presence of animals in the home. These variables were monitored to ensure that the results achieved in the project can be associated with interventions targeted at managing ragweed.

In addition, the project established study in a control site to add to the confirmation that mobilization in the project activities may be associated with the observed results. This methodology adds to the understanding of the problem, the allocation of the results achieved to the interventions, and influence factors emerging. This collection of evidence contributes to the confidence of the institutions responsible in the design and financing of a program that the measures put in place are achieving results, as well as identify other potential consequences, whether positive or negative.

Problem structuring

The health case study began with a fairly specific problem identified that it sought to address-ragweed allergies, as well as fairly clear causes for those allergies – ragweed plants and pollen. The intervention structure itself could be defined as linear with intermediate outputs, each dependant on the previous:

Mobilise community to manage ragweed -→ reduce ragweed (output 1) -→ results in reduced pollen concentration (output 2) -→ reduced allergies (output 3) --→ improved quality of life (Outcome)

Complexity (as described in section 2.1) was recognized in the measurement of the Outcome, reduced quality of life, by introducing indicators for influence variables that might influence the Outcome.

Alternatively, if the project researchers had begun with the objective of improving quality of life, they may have identified multiple chains of interventions related to improved public health, such as stress reduction activities, access to regular health check-ups, and nutritional education programs. Each of these lines of intervention would then be measured as outputs. The opening hypothesis that one begins with in evaluating a problem and solution greatly influences the measure of effectiveness of a project.

The hydro-sector project began with a complex problem structure, where one cause (river derivation) had several effects to be measured related to impacts on fish population and fishing grounds, water quality, forest health, animal sanctuaries as well as social impacts such as effects on traditional hunting and fishing grounds. These multiple variables merged to meet the objective of the environmental monitoring and evaluation programme: to monitor and verify the scale of environmental impacts as identified during the evaluation.

The evaluation itself was a broad based environmental and social impact assessment (ESIA), which by its nature seeks to identify all the possible negative consequences of a project. ESIA's may offer valuable insights into conducting broad based evaluations for identifying all drivers of vulnerability.

PART B. Climate Change Adaptation Discussion

5. Relevance of the analogue studies to climate change adaptation M&E needs

In March 2012, a National workshop organized in Montreal on measuring progress on adaptation identified a number of challenges related to measuring progress on adaptation to climate change. Many of the challenges existing for adaptation are common to M&E general, with additional aspects due to the nature of climate change. The following section examines how these challenges were addressed and managed in the two analogues.

i. Attribution (between the cause and effect): Because of the difficulty in separating out climate change risks from other stressors and drivers, the attribution of results to specific adaptation interventions is challenging (UNDP, 2007; Brooks, N. presentation June 2011, UNFCCC, 2010). This can be a problem for climate change adaptation where the issue is inherently complex, long-term multi-sectoral and therefore defies simple cause and effect analysis (UKCIP, 2014).

As in most subjects, assigning achievement of success to measures put in place in a project. The case studies both attempted to separate out project effects from other factors by establishing control sites where data was collected alongside the intervention areas. Another technique used in the health case sector was to identify and monitor influence variables, such as the presence of pets in the home, which could influence the allergy symptoms but were not related to the ragweed problem. This allows the evaluators of the programs to isolate the cause and effect more closely.

ii. Observability and Timescales : Technically speaking, the success of adaptation will only be apparent in retrospect. Particularly when the objectives of an intervention are intended to address long-term climate change impacts (IIED, 2011). Hinkel (2011) points out that it is not technically possible to measure vulnerability to climate change, because, strictly speaking, vulnerability is not an observable phenomenon (Moss et al., 2001; Parr et al., 2008, in Hinkel, 2011). Therefore, proxy indicators are selected which represent, to the best of our knowledge, the state of vulnerability of a given system or, related, factors which are considered to create adaptive capacity to climate change. An example of the former could be the degree of coastal erosion being observed and the trend, which could be monitored over the long-term using, for example, regular vulnerability mapping. The ability to adapt to this could be the existence of the vulnerability maps and, evidence of enforcement of a zoning law to avoid development of these areas, such as rejected development applications by a city council.

The analogues both identified planned outcomes and impacts that were realizable and measurable within the project scope both technically and within the time limit of the projects, that is within four to five years. The measures being implemented, such as managing ragweed or watershed management, bore results in the short term that could be measured. Extending the overall intended impacts, such as improving the long-term health of Canadians, would not be as easily measured within the scope of such projects.

iii. Establishing the Baseline and a shifting baseline: The baseline usually refers to the conditions that exist at a given point, usually the start point, of an activity, study, or project.[4] Establishing a baseline is important because progress can only be measured against stated and identified pre-existing conditions (Moser, 2009). Adaptation to climate change, however, by definition takes place against a shifting climatic baseline (IIED, 2011).

One to two years before the beginning of the projects, the analogue studies established baselines for the issues to be addressed to establish a longer-term trend. This was also used to identify project targets and contributed to understanding the nature of the problems being addressed.

In traditional project, a baseline is established at the beginning or a project to establish the state of things, and it is assumed to be static over time. However, in the context of climate change, not only do socio-economic parameters evolve with time (i.e. population growth) but so does the climatic context, where parameters such as average rainfall are shifting. This contributes additional uncertainty in understanding the effectiveness of a given measure. UKCIP (2004) therefore notes that simply comparing before and after an intervention may not be sufficient for CCA but the shift in the baseline should also be understood over time. Given that climate is evolving, this means that not only should the M&E system be flexible, but the programme objectives should evolve as new information becomes available. Flexibility can become a management trait which becomes more valued.

iv. Dealing with Uncertainty: Baseline information needs to include climate variability and other social and technological factors. However, these factors are constantly changing, so that M&E takes place against a —moving target. This means that climate and environment data becomes indispensible to monitoring against climatic conditions (IIED, 2011). Also, the uncertainty about climate change projections means that risk management will take place in highly uncertain scenarios (Villanueva).

CCA involves a “cascade of uncertainties” , illustrated in Figure 5 below, which scope of the uncertainties related to climate change adaptation.

Figure 6. Cascade of uncertainties (Wilby and Dessai, as cited in UKCIP 2014)

There are three ways that the projects dealt with uncertainty. Firstly, the hydropower project tried to minimize the effects of uncertainty by collecting a broad range and long set of biophysical indicators, in order to ensure that it was capturing a wide range of potential impacts. Secondly, traditional knowledge was integrated into decision about resource management to verify that these biophysical indicators were correct. The health sector project also integrated social qualitative data from surveys with quantitative data on pollen concentrations collected with Rotorod sensors. Thirdly, adaptive management – adjusting decisions regularly based on monitoring and evaluation of results in a regular basis helped improve decisions as new information and knowledge came to bear on project objectives. IN addition, UKCIP (2014) recommends establishing a baseline to track contextual changes, ensuring that the evaluation process also examines the assumptions that underpin a programme as well as emerging issues, and that flexibility is as important a measure of success as the results themselves. The analogue studies illustrate different ways that these approaches can be put in place.

v. Measuring effectiveness and Cost-Effectiveness: Decisions about where and how to finance initiatives are often, In using such tools, the benefits of adaptation are measured in terms of value, economic loss, or losses avoided. The assumption, however, is the ability to determine a baseline and projected benefits and losses. It also assumes ―rational‖ decision-making processes are in place (Villanueva). While cost effectiveness is clearly desired, the emphasis on the individual or community is likely to be related to their well-being and quality of life.

Neither case study integrated economic considerations into their monitoring and evaluation plans and rarely are, partly because methods such as cost benefit analysis are used as a basis to make decisions rather than to monitor the effectiveness of a given measure. In the hydro sector case, a post project economic analysis was conducted two years after project completion as a contribution to assisting decisions on whether to expand the program as part of public policy to reduce allergic effects from ragweed. The hydro-sector pilot project does not approach the issue, as the monitoring and evaluation of social and environmental impacts of the diversion project were a legal requirement and safeguard measure. In such cases, cost effectiveness may not be a criteria of importance.

Effective adaptation is also one that avoids maladaptation. In planning and designing adaptation strategies, one can unintentionally create negative externalities, reducing vulnerabilities in one area while increasing it in others, whether related to climate change or not. Maladaptation can take the form of i. increases in GHG emissions, ii. Inequity, iii. High opportunity costs, iv. Reduced incentive and capacity to adapt, v. setting paths that limit future choices (Barnett and O'Neil, 2010). Indicators can be established to monitor for maladaptation within or outside of the scope of a given project. In this way, the M&E plan is tracing both positive as well as monitoring for potential negative effects of adaptation strategies. This draws from the impact assessment approach used in the hydro-sector (monitoring for potential negative impacts of the project), as well as the use of influence variables in the health sector project which allowed researchers to isolate the effects of the initiative from other influences of the results.

vi. Consultation and Participation through M&E: Stakeholder participation in the assessment process can increase credibility in the eyes of participants yet —experts and even decision makers may see the results of assessment as of lower technical quality and therefore be compromised (Moser, 2009).

The Hydro project has highlighted the need to focus more attention on local knowledge before deciding on interventions for both reasons of effectiveness and public acceptance. In this specific case, the perception management was a vital issue for the conduct of the proposed project because the regional environment had undergone several changes already which were affecting the traditional hunting and fishing habits of the Cree population.

The ragweed study showed that mobilization based on a concerted management of interventions for the control of ragweed resulted in a sustained and dedicated involvement of the various partners and invited organizations, who's contributions were essential to the project's success.

vii. Criteria for Measurement: Decision makers often decide on resource allocations based on a number of criteria, which indicators need to capture, not least amongst them feasibility (often technical), efficacy/effectiveness, efficiency (often economic), acceptability/legitimacy, equity, and sustainability (Brooks, 2011).

In the case of the hydropower project, the criteria were to a large extent determined based on Panel recommendations from the environmental and social impact assessment that had been conducted. The objective of the monitoring plan therefore largely impacted the indicators selected. In the case of the health pilot project, an underlying objective was to collect information to identify whether the ragweed control strategy was effective in improving quality of life. A more developed causal chain was developed which reflects the analysis and learning components to the project. Greater multisectorialism was also evident because of this as the proponents were seeking to control the root causes of the health impact, and had a mandate which allowed it to reach wide.

viii. Data Availability and Collection : Practical and operational considerations are also important when deciding on indicators, such as availability or existence of data; potential availability of data; whether the available indicators measure important and determining factors rather than minor ones; and whether data is available continuously (Harley and van Minnen, 2009). Moser (2009) adds that factors to consider include time, cost, skill, capacity, and logistical practicalities (Moser, 2009). The literature is relatively silent on data collection at any scale, perhaps because the theoretical frameworks are still only just being developed in peer-reviewed journals. A recent UKCIP report (2013) suggests that existing indicators can be used for adaptation, and this may be preferable in many cases.

Both projects collected new data for each project. In the case of the hydro-sector pilot project, as the objective was short-run, data collection ended once the project ended. The data was collected by each of the three groups responsible for the different components, mobilization, health and environment, and shared annually between themselves in order to make needed adjustments and record progress. The overall evaluation, including the economic evaluation, was done after the end of the project by a group of researchers not directly responsible for the day-to-day management of the project, not to assess the performance of the team, but to assess whether their own hypothesis was correct in assuming the project activities would result in reduced allergies.

The hydrosector project was different in that the monitoring system fell out from the environmental and social safeguards requirements. Data may need to continue to be collected as long as the project site is in operation. The efforts were substantial and reflect the objective of the potential risks of the project. Parallels might be made to monitoring adaptation interventions with potentially high negative risks. Also, upstream monitoring – of vulnerability rather than the effects of adaptation, might be assessed in a similar way.

In both cases, assessing the existing data alongside climate data may be an easy way to use existing data collection efforts to draw linkages between sector objectives, in health and energy in these cases, with climatic trends. Especially in the case of the hydropower project, where data will be collected for a long period of time, opportunities for integrating climate change vulnerability and adaptation objectives may be fairly easy.

Moreover, as in the case of ragweed, other factors influence outcomes, without be treated under the program, can be similarly study and evaluate to contribute a learning on adaptation to climate change and also to permit the allocation results to relevant interventions. In adaptation, the selection of variables to detect unexpected **mal-adaptation** is important, given the level of complexity and uncertainty in these projects. This is necessary also to replicate good practices and to avoid encouraging ineffective strategies. The assessment by evaluation issues approach can contribute to the identification of relevant issues depend on the design itself of a program (Rogers, 2008).

6. Conclusions

This paper began with an overview of some of the theoretical contributions and trends in the evaluation literature in order to help the reader get a foothold on some of the basic concepts in this area. The two analogues were then described in terms of their objectives, M&E structures, data collection techniques, use of M&E for adaptive management and some of the useful techniques and best practices that were used.

This allowed us to identify how the different objectives for the M&E system itself (i.e. research, adaptive management and legislative) affect the identification of indicators that are monitored. The analogue studies were particularly strong in their application of tools for adaptive management, which was strengthened through high levels of participation by affected populations and flexible responses, by a mixture of qualitative and quantitative data, and by integrating social impacts to validate biophysical data. Iterative learning and adjustments, which is the core of adaptive management, was also strengthened in both cases by establishing control sites and monitoring influence variables in order to both learn from the implementation of measures and to isolate the effects of the interventions from other factors that could influence the project outcomes.

The recent literature in the evaluation area discusses the use of evaluation to identify the drivers of change for a given planned impact, and tends to cast the net wide at the beginning of a project conception. The number of issues to be addressed are defined by a project scope, and the effectiveness of a project is then determined within that scope – i.e. how effective was the project in achieving its defined objective. However, this is often a simplification of any real world problem which is usually complex, too complex to be managed within a project. The analogue studies showed that one of the ways to consider influences on one's project objectives is to monitor indicators of those influences. This was the case in the health project, which monitored other variables that can influence health. This is particularly important for adaptation to climate change because vulnerability of a population is affected by so many different influences other that climate itself.

The analogue studies also allowed us to identify that many of the challenges related to monitoring and evaluating adaptation to climate change can be found in most M&E set-ups. Further work could seek to identify how the integration of climate change adaptation objectives into a sector project would influence the project structure itself, and the indicators to monitor its effectiveness. Examples of proxy indicators for vulnerability and adaptive capacity need to be identified through such concrete examples, confirming whether existing data will suffice, and if not then the marginal effort required.

Annex A. Environmental monitoring activities undertaken for the Centrale de Eastmain 1-A and the derivation of Rupert river (source: Etudes d'impact sur l'environnement – Rapport de Synthèse 2009)

Tableau 11-1 : Programme de suivi environnemental

Géomorphologie

- Évolution des berges dans le tronçon à débit réduit de la Rupert.
- Évolution de la stabilité des berges dans le tronçon à débit réduit de la Rupert (PK 7, 101,5 et 107) et de l'état de l'ouvrage de protection situé à proximité de la prise d'eau de Waskaganish.
- Érosion des rives en aval de l'aménagement La Grande-1 et efficacité des tapis granulaires.

Hydrologie et hydraulique

- Comportement hydraulique des biefs Rupert, du cours aval des rivières Rupert, Lemare et Nemiscau ainsi que des plans d'eau du secteur à débit augmenté.
- Niveaux d'eau dans l'estuaire de la Rupert.
- Intrusion saline dans la baie de Rupert.

Régime des glaces

- Couverture de glace des biefs, de la Rupert, de l'Eastmain, du réservoir Opinaca et du parcours Boyd-Sakami.

Qualité de l'eau

- Qualité de l'eau de la rivière Rupert.
- Qualité de l'eau à la prise d'eau de l'usine de traitement d'eau potable de Waskaganish.
- Qualité de l'eau de l'estuaire de la Grande Rivière.

Poissons

- Communautés de poissons dans les biefs et dans la rivière Rupert.
- Accessibilité pour les poissons des tributaires de la rivière et des biefs Rupert.
- Capacité de production piscicole des biefs et de la rivière Rupert.
- Frayères à touladi existantes dans le lac RP030, les frayères à esturgeon jaune du cours aval de la Rupert, et les frayères à cisco de lac entre les PK 14 et 23,5 de la Rupert, les frayères des PK 216 et 280 de la Rupert ainsi que la frayère située à l'embouchure de la rivière Boyd dans le lac Sakami.
- Tous les aménagements piscicoles (mesures d'atténuation et de compensation).

Milieux humides et espèces vasculaires particulières

- Végétation riveraine et aquatique sur les rives des biefs.
- Végétation riveraine et aquatique sur les rives de la rivière Rupert ainsi que la végétation riveraine de la baie de Rupert.
- Population de *Gratiola aurea* sur les rives de la rivière Rupert.

Végétation forestière

- Relevé de la quantité et del'emplacement des débris ligneux flottants, analyse du comportement et de l'évolution de ces débris et consignation des zones d'accumulation.

Faune terrestre et semi-aquatique

- Animaux mis en péril dans les biefs et sur les îles pendant le remplissage des biefs.
- Inventaire d'orignaux et de caribous dans le secteur des biefs.
- Inventaire des colonies de castors sur les rives des biefs et de la rivière Rupert.
- Évaluation de l'utilisation des milieux humides aménagés ainsi que des rives des biefs et de la rivière Rupert.
- Campagne de piégeage de micromammifères.

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