



## Applying Livelihood Methods for Climate Change Adaptation

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### Introduction

Many British Columbia communities rely on forests to meet their economic, recreational and cultural needs, climate change and consequent changes in forest management can significantly affect these needs. People exist within a context of complex multi-scale social, economic and ecological systems. To help communities adapt to change, it is critical to describe these socio-ecological systems—to clarify different scales of decision making, where communities fit in, how people will be impacted, what they have control over, how and who can respond to climate change.

This report presents the results of testing a community livelihood methodology and its application in north-western BC. The background theory to the method is initially presented along with the context of the assessment. A structured methodology is shown integrating sustainable livelihood and integral theory approaches in developing an assessment of livelihoods in the context of climate change in north western BC. Finally, reflections on the application of the method and areas of improvement are discussed.

## Background

Social-ecological systems theory views resource management as the integration of natural and human dynamics and the capacity of the system to respond to change while maintaining its defining functions and structures (Holling 1973, Gunderson and Holling 2002, Drever et al. 2006). In this context, resilience represents the ability of ecosystems and human communities to maintain their defining features and processes following natural and human disturbance. Adaptability is the capacity of the ecosystems, species and human actors in the system to adjust to both ecological and social change. Transformability is the ability of the system to transform from its current configuration to a different configuration. The transformation is triggered when the resilience and adaptability to disturbance is overcome and a new system emerges, organized around a different set of defining structures, functions and controls (Walker et al. 2004).

A climate change vulnerability assessment involves an iterative process to progressively add in, integrate and account for the interactions between the biophysical and socio-economic realms, and climate change. It typically includes steps to evaluate the impacts and potential biophysical consequences (the exposure and sensitivity of aspects of the system to climate change), evaluate the vulnerability of ecological and human dependent systems to these impacts, and identify adaptation options and the capacity of the human and ecological systems to change.

Methods for investigating community livelihoods lend insight into social-ecological resilience, adaptation and transformation under a changing climate. As well, from vulnerability perspective the adaptive capacity of communities can be evaluated. The standard definition of livelihoods is that of Chambers and Conway (1992):

“A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base.”

Sustainable livelihood thinking considers the coping and adapting mechanisms that people use in response to the dynamic nature of the social-ecosystem system that they live within, which are not typically captured in traditional climate change vulnerability assessments that focus on employment, production, markets, and forestry systems. Livelihood assessments have been applied extensively around the world in a variety of settings for evaluating a range of cultures, ecosystem services and vulnerabilities, including climate change (Hussain 2002).

With the inherently interdisciplinary nature of the questions posed, a framework was sought that could not only foster dialogue between the disciplines but also coordinate and integrate meaning among them. Integral theory provides a basis for developing this type of transdisciplinary methodology to foster greater understanding of communities and climate change adaptation that meshes well with the concept of livelihoods. Integral frameworks map out the individual and collective into subjective and

objective domains. By forming questions that help to inform each domain of the framework a richer understanding of community adaptive capacity can be gained. This project integrated integral concepts into the livelihood methodology.

## Project Context

Livelihood assessment methods are being applied in north-western BC as part of a research project investigating climate change vulnerability and adaptation. A traditional vulnerability assessment has been conducted (see [http://bvcentre.ca/research/project/a\\_multi-scale\\_trans-disciplinary\\_vulnerability\\_assessment/](http://bvcentre.ca/research/project/a_multi-scale_trans-disciplinary_vulnerability_assessment/)) that describes the local forest management regime and outlines management adaptation options. This vulnerability assessment provides the background and context for evaluating the implications for local communities of changing climate.

Livelihoods approaches are based on a conceptual framework to aid analysis of the factors affecting peoples' livelihoods, including (adapted from Eldis <http://www.eldis.org/go/topics/dossiers/livelihoods-connect>):

- the priorities that people define as their desired livelihood outcomes
- their access to social, human, physical, financial and natural capital or assets, and their ability to put these to productive use
- the different strategies they adopt (and how they use their assets) in pursuit of their priorities
- the policies, institutions and processes that shape their access to assets and opportunities
- the context in which they live, and factors affecting vulnerability to shocks and stresses.

To conduct a livelihood assessment the assets of a community need to be identified along with the relevant stressors on those assets. There are 5 basic assets:

1. Natural capital – natural resource stocks (soil, water, air, forests, etc.) and environmental services (hydrological cycle, etc).
2. Economic or financial capital – the capital base (cash, credit/debt, savings, etc.).
3. Human capital – skills, knowledge, ability to labour and good health.
4. Social capital – social resources (networks, social relations, affiliations, associations, organizations, etc.).
5. Physical capital – infrastructure (roads, railways, water, schools, processing and manufacturing facilities, etc.).

In the list above, it becomes apparent that some of these assets can be assessed objectively and quantitatively, as they relate with the exterior, tangible domains of a community, such as natural resources, environmental services, financial capital base, and infrastructure, for example. However, other assets relate with the more subjective, qualitative, or, what could be referred to as, the *interior domains of a community*, such as knowledge and social relations. To comprehensively include these

interior dimensions in a livelihood assessment requires expanding the assessment tools to include these more subjective, qualitative aspects. Knowledge, for example, cannot only be assessed objectively in terms of educational degrees held, since it also includes awareness, understanding of the issues, values and motivation for adaptive change, and so forth.

A need exists to better understand and assess these interior domains in regards to climate change response (O'Brien and Hochachka, 2010, O'Brien, in press). Referred to as the 'human dimensions', these are the more psychological and social dimensions of the issue, and include such things as motivation, personal resilience, and awareness.

Often the reasons for a slow or absent uptake in climate change action can be traced back to these human dimensions. In other words, it may not be for lack of technology, innovations in infrastructure, or a sufficient tax base to support adaptive change, but rather the lack of political will, insufficient alignment with cultural values, and lack of personal motivation (all interior human dimensions) that will stall a process towards adaptation to climate change.

This project sought a framework that could integrate both these interior and exterior domains, in search of a more effective impact in the community. Integral Theory presents such a framework, one that integrates the exterior and interior domains of communities. The following four-quadrant diagram shows how the human dimensions (the interior of the individual and collective) are often the focus of the social and psychological sciences, while the behavioural and systems dimensions (the exterior of the individual and collective) are often the focus of the physical and natural sciences.

In figure one, the four quadrants are described and examples given, with a list of the methodologies that tend to be employed to research and engage each domain.

	Interior	Exterior
Individual	<p><b>Awareness and Experience</b></p> <p>Eg. Values, mindsets, understanding, knowledge, motivations, self-identity.</p> <p>Methodologies: psychology, consciousness studies.</p>	<p><b>Behaviours</b></p> <p>Eg. Actions, land use practices, lifestyle choices, health indicators.</p> <p>Methodologies: behavioural science, physical science, and some forms of psychology such as cognitive and behavioural psychology.</p>
Collective	<p><b>Culture</b></p> <p>Eg. Shared worldviews, social discourse, cultural norms, traditional customs.</p> <p>Methodologies: social science, cultural studies, anthropology, hermeneutics.</p>	<p><b>Systems</b></p> <p>Eg. Ecosystems, financial systems, political and judicial systems, communication technology systems, infrastructure systems (i.e. transportation).</p> <p>Methodologies: natural sciences, economics, political science, systems theory, and so forth.</p>

**Figure 1: Integrating Human Dimensions of Climate Change Using Quadrants of Integral Theory.**

Using this framework, livelihood assets were mapped into the quadrants as an attempt to integrate the right-hand and left-hand sides of the diagram, representing the exterior and interior dimensions of community. In so doing, gaps in the livelihood assets were discovered, such as a heavy emphasis on the systems assets and less emphasis on the interior human capital and interior social capital. To adjust for these gaps and ensure a comprehensive approach, some assets needed to be added (see italics in the figure below).

Also notice how human capital relates *both* to the exterior (skills, ability to labour, good health) as well as the interior (knowledge, values, mindsets, and awareness). Similarly, social capital can relate with the exterior forms of social organizing, such as networks, affiliations, and organizations, as well as the interior forms of cultural organizing, such as the cultural customs of networking and ‘helping one’s neighbour.’ Using Integral Theory brought more granularity to the livelihoods assessment to include these slightly, but importantly, different aspects of the livelihood assets.

	Interior	Exterior
Individual	<p><b>Awareness and Experience</b></p> <p>Human capital – knowledge, <i>values</i>, <i>mindsets</i>, and <i>awareness</i>.</p>	<p><b>Behaviours</b></p> <p>Human capital –skills, ability to labour and good health.</p>
Collective	<p><b>Culture</b></p> <p>Social capital –cultural resources (social relations, <i>cultural customs of networking</i>, <i>traditional custom of ‘helping one’s neighbour’</i>, <i>cultural resilience to impacts</i>, etc.).</p>	<p><b>Systems</b></p> <p>Natural capital –natural resource stocks (soil, water, air, forests, etc.) and environmental services (hydrological cycle, etc).</p> <p>Economic or financial capital – the capital base (cash, credit/debt, savings, etc.).</p> <p>Social capital –social resources (networks, affiliations, associations, organizations, etc.).</p> <p>Physical capital – infrastructure (roads, railways, water, schools, processing and manufacturing facilities, etc.).</p>

**Figure 2: Mapping Livelihood Assets with the Quadrants of Integral Theory**

***Project Goal and Objectives***

In summary, the goal of this component of the broader multi-scale transdisciplinary project is to test methods to support adaptation of communities to climate change using the concept of sustainable livelihoods, augmented with integral theory. The objectives of the sustainable livelihood assessment are first to help participants understand local livelihoods and the links between local livelihoods and climate change, and second to evaluate adaptive capacity, particularly in the context of adaptation strategies suggested in the vulnerability and adaptation assessment conducted in the Nadina Forest District.

**Methods**

The methodology combines a technical livelihood assessment within an integral context. The assessment was conducted using the Bulkley Valley as a case study. The technical aspect of the livelihood assessment follows the methods of IUCN et al. 2007. Their methodology and Excel-based tool (“Community based Risk Screening Tool - Adaptation and Livelihoods” or CRiSTAL) has helped build local

adaptive capacity and design activities that increase a community's resilience to climate change based on local conditions, strengths and needs (Stejskal and Fernandes 2006, Riche 2007, and others—see <http://www.cristaltool.org/content/exp.aspx>).

The Integral theory framework was used to pose questions from each quadrant to ensure that both the human dimensions and natural sciences dimensions were included (the left-hand and right-hand side of the quadrants). It was also used a heuristic tool in a workshop setting to facilitate a more inclusive and deeper inquiry into the livelihood assets currently present or needed in the community regarding climate change adaptive capacity. Finally, the quadrants of the framework were considered in the overall design of the project so to engage various modes of adaptive capacity within the research activities themselves.

The methods tested included the following components:

1. Climate change impacts and local forest resource system vulnerability.
2. Scenario planning workshop held with natural and social scientists and diverse range of community leaders.
3. Sustainable livelihood community workshop.
4. Application of Integral Theory to Livelihood Assessment.
5. Summary of livelihoods and impacts using the CRISTAL spreadsheet tool.

### ***1. Climate change impacts and local forest resource system vulnerability***

The livelihood assessment incorporated the results from a linked vulnerability assessment project conducted in the Bulkley Valley and areas to the east. The vulnerability assessment described the potential effects of climate change on several managed forest values—timber, biodiversity and hydrology/aquatic ecosystems—in the Nadina Forest District and explored potential management responses. Estimates of the effects of climate change (vulnerability) and of management responses (adaptation) were based on the results of participatory workshops that included forest managers and topic experts. An initial workshop defined the scope of the project. Then three “technical” workshops (one for each forest value) reviewed climate change projections and developed conceptual models of ecosystem response to climate change and forest management. Conceptual models provide logical constructs for organizing ideas about how climate change will influence selected forest values. They serve to focus workshop discussion on the most relevant ecological and management variables. A final workshop reviewed the potential effects of climate change and developed management responses.

### ***2. Scenario planning***

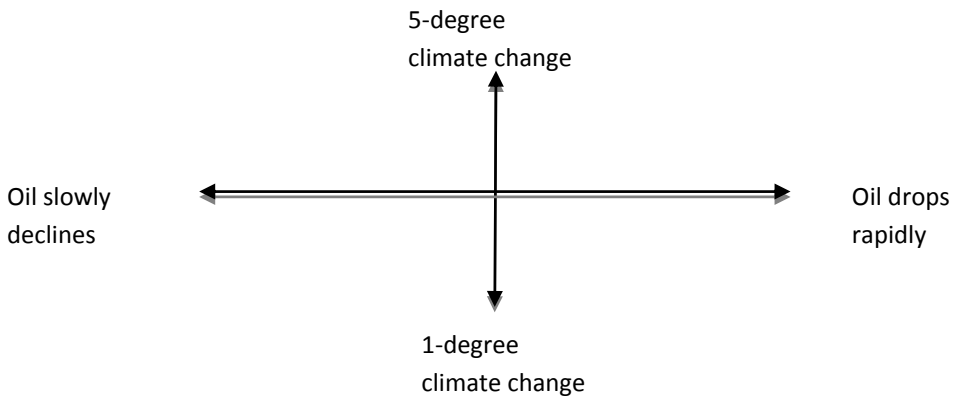
With global issues that span national boundaries and exceed the timelines that people and politicians tend to think and plan in, the methodology of scenario planning has been found to be useful (MA 2005). Scenario planning, also called scenario thinking or scenario analysis, is a strategic planning method that some organizations use to make flexible long-term plans. It has a history of use in the military as well as the corporate sector, but more recently has been used in the Millennium Assessment and also in the

Intergovernmental Panel on Climate Change (IPCC 2007). Since the timelines for planning for climate change adaptation, and the factors and conditions that need to be accounted for, require a thought-experiment rigorous enough to expand our thinking beyond its normal range, scenario planning is an excellent option as a planning tool. Scenario planning may involve aspects of *systems thinking*, specifically the recognition that many factors may combine in complex ways to create sometime surprising futures (due to non-linear feedback loops). The method also allows the inclusion of factors that are difficult to formalize, such as novel insights about the future, deep shifts in values, unprecedented regulations or inventions.

In this project, it was tested at the local and bioregional level in regards to climate change impacts in the Northwest. In partnership with the non-profit organization One Sky-The Canadian Institute of Sustainable Living, the Bulkley Valley Research Centre held a two-day workshop to explore and examine potential scenarios over the coming 25 years in a context of 1) a changed climate based on current understanding of the impact of climate change for our region, and 2) the evolution of “peak oil” and/or the use of non conventional fossil fuel. All this is of course embedded in the continued globalization of our economies and the impact of increasing demographics on northwestern BC. The exercise sought to better understand how the possible scenarios might play out and to better understand local perspectives on the issues of resilience, leadership and climate change.

The methodology involved having specialists give presentations on how climate change and peak oil are expected to affect the local region in the context of globalization, while participants discerned and analyzed the categories of stressors and drivers for climate change and peak oil in the region. Then, setting an x and y axis with variables pertinent to climate change and peak oil, a ‘scenario space’ was created (see figure three) which small groups then filled out, first globally and then in regards to the local conditions of the community and region (see photos in Appendix 4). Participants were tasked to ensure that each scenario was ‘internally coherent’ and to consider the ‘drivers’, ‘responses’, ‘game changers’, and ‘breakthroughs’ in regards to each possible scenario. This moved into a discussion on community resilience, again considering the four-quadrants.





**Figure 3: Creating the scenario space by setting parameters and looking at the possible scenarios until 2050.**

### **3. Livelihood workshop**

To engage participants further on sustainable livelihoods, a single workshop was held to engage the community, collect information on livelihoods, and help to build adaptive capacity. It was originally conceived as two workshops; the first with the Wet’suwet’en, who reside in the Bulkley Valley, to focus on the aboriginal context; the second with local non-native communities. Upon further consideration, it was determined to be more appropriate to merge the two workshops into one, which better represents ‘community’ – inclusive of all groups, ethnicities and segments of society. To gather a sociocultural and First Nation perspective, an anthropologist was engaged to integrate an aboriginal perspective.

The workshop consisted of the following activities, which are elaborated in the Results section below:

- a) Setting the stage
- b) Inviting interiors
- c) Past peoples
- d) Self inquiry into participant’s own past peoples
- e) Exploration of climate change impacts
- f) Livelihood assets and possibilities of community resilience.

### **4. Application of Integral Theory to Livelihood Assessment**

The Livelihood Assessment methodology goes far in gaining a more complete picture of a community’s resources and assets in times of turbulent change. To further account for the inherent, interior dimensions of communities, Integral theory was applied to the livelihood assessment, as described above. The four quadrants gave a clear framework for how to integrate these human dimensions into the livelihood assessment by mapping livelihood assets onto each quadrant, and also assisted the project in aligning and integrating disciplines as diverse as ecology, social theory, anthropology, and

even psychology to a certain degree. Applying Integral theory occurred at the design phase of the project, in selecting the team of researchers and facilitators, as well as explicitly in the project's community engagement methodologies, particularly by including didactic presentations from specialists, participatory dialogue, and moments for self-reflection (each of which relate with a different quadrant of the model). It also assisted the project in accounting for the different types of adaptive capacity that are necessary in moving from the livelihood assessment into adaptation planning, which is described further below.

### **5. Summary of livelihoods and impacts**

The CRiSTAL tool was used to document people's relation to climate change, either directly or through biophysical changes. Suggested forestry climate change adaptation activities were evaluated for their relation to community coping strategies. To populate the Livelihood Assessment the workshop (3 above) was structured to incorporate four main questions (adapted from IUCN et al. 2007):

1. What is the climate context, including anticipated impacts, current climate related hazards, and what are the coping strategies to deal with these impacts?
2. What is the livelihood context, identifying what resources are important to local livelihoods, how are these resources affected by climate hazards?
3. What are the impacts of forestry climate change adaptation activities on livelihood resources that are vulnerable to climate change and to local community coping strategies?
4. How can forestry climate change adaptation activities be adjusted to reduce vulnerability and enhance adaptive capacity?

The CRiSTAL tool has two modules. The first module synthesizes information on climate and community livelihoods. The second is structured to evaluate the planning and management of a specific project. The first module was fully addressed by the project. For the second module two hypothetical cases – forestry and agriculture - were assessed, given that there was no specific development project being considered by the broader research project. The evaluation of forestry provided an opportunity to describe current forestry related activities and how they may be impacted by climate hazards – natural disturbance events triggered by climate change. Agriculture was hypothetical, given that there was no specific technical focus on agriculture in the overall project. However, project participants thought that agriculture, an important activity in the Bulkley Valley, would have a strong interaction with a changing climate.

## **Results**

### **1. Climate change impacts and local forest resource system vulnerability**

Climate change will affect both the terrestrial and aquatic ecosystems that form the forest around the Bulkley Valley. Terrestrial plants, including trees, must respond to changes to underlying environmental conditions and disturbance regimes. Conservation values will be affected. Expected warmer temperatures will likely increase stand-replacing and stand-altering disturbance due to insects, disease

and possibly fire or drought, and favour exotic invasive species, leading to a loss or degradation of old forest ecosystems. Changes to snowpack and snow conditions (e.g., more frequent freeze-thaw cycles) are uncertain, but have the potential to reduce the value of winter habitat for focal species such as deer.

Timber supply will probably decrease and become more variable. The effects of climate change on timber supply are highly uncertain, reflecting tradeoffs between increased tree growth, due to longer warmer growing seasons and increased carbon dioxide concentrations, and increased unsalvaged mortality, due to increased natural disturbance. The periodic nature of large natural disturbances will produce pulses of dead salvageable timber, but will reduce the supply of green timber.

Changes in hydrology pose risk to infrastructure and aquatic communities. Roads, bridges and buildings face risk from possible increases in peak flows and flooding. Potential impacts to aquatic communities include increased stream temperatures, increased erosion (scour) and increased landslide risk. Some salmon stocks and bull trout cannot tolerate high water temperatures. Erosion and landslides can add sediment to streams, affecting aquatic communities and spawning beds.

Vulnerability assessment results can be found at [http://bvcentre.ca/research/project/a\\_multi-scale\\_trans-disciplinary\\_vulnerability\\_assessment/](http://bvcentre.ca/research/project/a_multi-scale_trans-disciplinary_vulnerability_assessment/).

## **2. Scenario planning**

Four possible scenario spaces were delineated from the x and y axes of increasing severity of climate change and peak oil. The results from this included robust and ‘internally coherent’ descriptions of these four possible scenarios. Detailed accounts of these are in Appendix 1 and also see photos in Appendix 4. Scenario planning tends to include a rather fun exercise of giving a name to each scenario. Thus, the participants entitled the scenarios as the following:

- *Transformation Through Chaos* (five degrees of climate change with lots of oil remaining),
- *Transformation By Design (also known as Polyanna)* (1 degree of change with lots of oil remaining),
- *Hail Mary* (1 degree of change with no oil), and
- *Oh Frick!* (five degrees of change with no oil).

For each of these, a list of stressors and drivers were considered (though not comprehensive, this list was sufficient to drive the scenario planning process). These included: extent of climate change, extent of oil resources, technology, governance, locus of control, state of global cooperation, situation in the global economy, and economic focus. Responses were also identified, including: ecological integrity, food security, climate migrants, standard of living, and population levels.

This led to a discussion on advocacy and use of the scenarios in further planning exercises, as well as group discussion on community resilience, considering the four quadrants of Integral Theory. Participants considered the results from the scenario planning and discussed what existing resilience was present in the community to face these possible scenarios. Figure 4 shows some of the key results of this discussion.

	Interior	Exterior
Individual	<p><i>Psychological resilience</i></p> <p>Intellectual capacity is high, values are neighbourly, sense of belonging and trust, connected to the land.</p>	<p><i>Behavioral resilience</i></p> <p>High level of skills, particularly agrarian skills, people still use the land and know how to reap natural resources, the population is characteristically fit and healthy.</p>
Collective	<p><i>Community resilience</i></p> <p>Diverse populations and traditional knowledge, high community organization, cultural norm of trading and sharing between First Nations, institutional organizational capacity is high, churches could be used as refuges, political interest and support is high, strong professional networks.</p>	<p><i>Systems resilience (such as ecological resilience, physical resilience, financial/economic resilience, technological resilience, etc.)</i></p> <p>High value real estate and local infrastructure like hospitals, credit unions, and educational institutions, diverse economy with a variety of economic activities, forest diversity and fresh water in abundance.</p>

**Figure 4: Considering community resilience in regards to the scenario planning findings.**

Finally, the results and process were synthesized into a methodological guide that could be used in other communities and regions. (See: [http://www.onesky.ca/stories/resilience\\_in\\_times\\_of\\_change/](http://www.onesky.ca/stories/resilience_in_times_of_change/). Retrieved February 28, 2012.)

**3. Livelihood workshop** (please see Appendix 2, Facilitator’s Agenda)

- a) Setting the stage
- b) Inviting interiors
- c) Past peoples
- d) Self inquiry into participant’s own past peoples
- e) Exploration of climate change impacts
- f) Livelihood assets and possibilities of community resilience.

**a) Setting the stage**

Following the transdisciplinary and integrative intention of this project, the workshop was designed and prepared with some important components in mind. To begin with, an interdisciplinary team was brought together, including the project coordinator who was trained in social and ecological systems, an anthropologist who was steeped in the past people’s history of the region, a social scientist familiar with

integral theory in the context of environmental studies, and a workshop facilitator uniquely able to engage participants through processes of reflection. From these different disciplines, this team of researchers naturally paid attention to the different kinds of adaptive capacity (in all quadrants), which in turn affected the way in which the workshop was prepared, how it was facilitated, and what content it covered.

Secondly, the invitation list for the workshop attempted to cover all sectors of the population—different hereditary backgrounds, genders, age groups, disciplines, and socio-economic sectors—so to include as many perspectives as possible from the community and region. Though not all invitees attended, attention to the diversity of participants was somewhat unusual for what is often considered a ‘scientific’ or ‘technical’ workshop topic, and set the stage for more representative cross-section of the communities in the region. Without losing a connection to the important insights of climate science, the workshop was framed around a dialogical engagement. This as described by the workshop facilitator in the following way:

“Dialogue is concentrated conversation among equals. It offers helpful ways to work together cooperatively, encourages mutual understanding between diverse perspectives, produces healthy professional and personal relationships and leads to stable resilient outcomes.”

Thirdly, the workshop was designed pedagogically to include first-person perspectives (self-reflective moments), second-person perspectives (group dialogue and participation), as well as third-person perspectives (those normally exercised in using the scientific method, and that which is found in presentations and other monological engagement).

For example, the workshop began with a process to examine *how* we talk in workshop about a complex issue like climate change. Participants generated a list of qualities on how they wanted to engage together in dialogue, which included: being aware of when one was speaking from ones’ own values versus from verifiable knowledge, to attempt to listen more and talk less in group discussions, to ask better questions, and to not shy away from challenging each other and ‘being edgy’ to push for excellence of outcomes. This is relevant at two levels: both for the outcomes of this specific workshop as well as in preparing for dialogue about adaptation at a larger scale. Regarding the latter, considering how certain sectors of the population tend to contribute to carbon emissions more so than others and the impacts of climate change are shouldered unequally across the population, building *interpersonal capacity* for how to dialogue and make decisions about climate change is crucially important. By directly engaging participants in this discussion on how they intended to talk together about a complex issue like climate change, the workshop sought to develop this individual and community interpersonal capacity, namely how to have inclusive, critically self-reflective, and pragmatic conversations about adaptation. In so doing, it moved from viewing “environmental justice” of climate change as a concept, into a lived reality of how we relate as a diverse community. This intention to balance and integrate first-, second-,

and third-person perspectives were present throughout the workshop, as described in more detail below.

### **b) Inviting Interiors**

Rather than holding climate change adaptation as merely a technical question, to which science and engineering should seek answers, this project sought to include human dimensions of the issue—definitely drawing on science but also including the personal and interpersonal aspects of the issue as well. That required that ‘interiors’ be invited and included in the workshop itself. This does not require a psychological or social theory background to do, but rather an openness of mind to include content that is subjective and experiential. The workshop did this in several ways.

For example, people introduced themselves not just with their name and profession, as what might normally be done in a workshop on climate change adaptation. Instead, each participant was asked to introduce themselves with their name and its history, including who gave them that name, its ancestry, and meaning. This inherently drew in more of people’s personal histories and their cultural backgrounds, and fostered a deeper sense of connection between participants. Though a simple methodological technique, it served to set a different invitation as to what would subsequently be brought into the discourse.

From that point forward, other examples for how interiors were invited included using storytelling as a way to help foster engagement and help the group notice commonalities. There was also an effort to level the playing field and facilitate discussions as if we were building something together wherein questions were encouraged and all ideas are given same weight. At the same time, there was recognition of the limitations in knowledge present in the workshop, and a self-reflective eye to when, where, and why the group discussion slipped into a more medical model approach, of looking at symptoms versus root causes of the issue. All these point to ways that interiors were invited and included in the workshop from start to finish.

### **c) Past peoples**

Indigenous peoples have always adapted to environmental change. Catastrophic paleoenvironmental or climatic events are and have been relatively constant, particularly in the Pacific northwest of North America. Indigenous groups are profoundly connected to their landscapes, and often adapt to and endure extreme environmental change. Native populations maintain that proof of their long occupation in their traditional ethnographic territories is embedded in their oral traditions. These oral accounts are the primary methods for recording indigenous epistemology, history and cultural change. When we examine some of these oral traditions, we find that native groups adapted to environmental change differently. In some cases, a native group never left the affected area, and simply endured the environmental event (such as a volcanic eruption, flood, drought, excessive snow and ice, etc). In other cases, a group would return to an impacted area after a certain period of time, perhaps once the resources are usable again. Sometimes, a group would never return, regardless of whether or not the

land is usable again. These cases are most interesting, as they demonstrate the power of cultural belief and ideology with respect to how we use our landscape. In other words, cultural beliefs can be prioritized over rational and functional ones. One may argue that in some current resource management contexts, this is a situation with which we are familiar.

An evaluation and use of the indigenous perspective within a western scientific framework may serve as a foundation for further work in this area. Eventually, a combination of the two perspectives may yield a richer, more holistic view of past peoples adaptations to environmental change, and inform us to better adapt to future environmental change. (A more detailed summary about past peoples adaptations to environmental change is seen in Appendix 3)

**d) Self inquiry into participant’s own past peoples**

Participants were asked to reflect on and discuss how they and their own ‘past people’ adapted to environmental changes. The results were that many people (including their parents and grandparents) had experience in adapting to environmental change. Participants spoke to localized events, such as excessive snow and ice, flooding and drought, and the impacts upon their families. They also mentioned how they adapted, and how it changed their behavior. For example, one workshop participant discussed having to deal with an extreme local flooding event, and how it impacted their home, livelihood and sub-community. Their specific adaptation was to relocate to another area on higher ground. However, other residents in that sub-community have remained. Interestingly, this is consistent with past people’s adaptation to environmental change. Table 1 lists the various types of assets used by participants in response to past environmental change as shared in their past peoples stories. These assets were found to include both the exterior (such as, financial capacity skills, fertile land, and rail/road transport) as well as the interior (such as, kinship, cooperation, and resolve) dimensions of community life.

**Table 1. Assets used in response to past environmental change identified in workshop participants past peoples stories.**

<b>Livelihood Asset</b>	<b>Description</b>
<b>Social</b>	Kinship, ability to market oneself, access to health care, education, ability to cooperate
<b>Financial</b>	Ability to purchase, financial capacity skills
<b>Human</b>	Backup and contingency planning, preparedness (back up generators, etc.), mobility (cars, movement, rail, etc.), ability to learn new skills, a deep sense of resolve
<b>Environmental</b>	Fertile land, domestic livestock, forests

<b>Physical</b>	Ropes, ladders, skis, dump trucks, snowplows, rail/road transport networks, health care system
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**e) Exploration of climate change impacts**

As part of the workshop a presentation was given outlining the possible impacts of climate change on extreme events globally (IPCC 2011). A local interpretation was provided in the presentation to familiarize the participants with potential local implications ([http://bvcentre.ca/files/research\\_reports/09-12SustainingLivelihoods.pdf](http://bvcentre.ca/files/research_reports/09-12SustainingLivelihoods.pdf)). The presentation was then followed with a workshop exercise to reflect on emotional response to the material presented and what aligned with pre-conceived notions, what questions it raised and what was most pertinent. A group exercise was then conducted to draw a picture of the risks and hazards that participants thought might come to bear in the next 20-50 years. (See photo appendix Participant Risk and Hazard drawings). The groups narrowed down the hazards to the most urgent and requiring the most livelihood assets to deal with and are shown in table 2.

**Table 2. Risks and hazards in the Bulkely Valley (20-50 years) as identified by workshop participants, the number of ‘x’s indicates the participant ranking of the risks and hazards.**

<b>Risk and Hazard</b>	<b>Participant Ranking</b>
Superbugs	xx
Fire	xxxx
Flooding	xxxx
Water	xx
Power	xxx
Transportation	x
Impact on natural resources (forests)	xxxxx
Food security	xxxx
Loss of salmon stocks	x
Human response/disengagement	x
Wind	

As a result of this exercise fire, flooding and food security were chosen as the final hazard candidates for the livelihood assessment CRISTAL tool.

**f) Livelihood assets and possibilities of community resilience**

Livelihood assets and possibility of community resilience were examined in regards to what the participants identified as the main climate threats to the region. One example is illustrated in the following figure 5, in which the livelihood assets from the past as well as the present are written, including the assets that have been lost or will need to be learned or evolved in the coming years.



	Interior	Exterior
Individual	<b>Awareness and Experience</b> Risk-taking Attitude of survival and self reliance <ul style="list-style-type: none"> <li>Has decreased but is better than city (new assets in people)</li> </ul> Propensity to fully utilize products (demonstrates the value of limiting waste)	<b>Actions and Behaviours</b> Sandbagging Farmers market—skills and actions to create and sustain a market for these local products Over-harvesting
	<b>Culture</b>	<b>Systems</b>
Collective	Knowledge-skills Kinship Connected to nature Disconnected from nature—an area of need for future resilience Some cultural tendency towards being highly wasteful Arrogance in regards to how natural resources are managed (command and control) Mass production <ul style="list-style-type: none"> <li>Diversity would go up, but so would the costs for these products</li> <li>Limits flexibility</li> </ul> Diversity of perspectives/talents Hypocrisy	Available arable land + Available water + Regulatory system—this is an area of need for future resilience, could be positive or negative Existence of a locally owned abattoir for local livestock products Predictive capacity (modelling) Presence of a good education system Presence of a good health care system Mechanization (machinery) Diverse economy – “not a one-horse town” Political decision making—this is an area of need for future resilience <ul style="list-style-type: none"> <li>Currently little to no incentive to address climate change</li> </ul>

Flooding, impacts on forests and food security

**Figure 5: Applying quadrants to examine past, current, and future livelihood assets and possibilities for resilience.**

**4. Application of Integral Theory to Livelihood Assessment**

The project applied the integral framework to engage various modes of adaptive capacity within the research activities themselves. This included both the technical capacities to engineer, scientifically understand, and pragmatically engage in adaptation (the Right-hand quadrants), as well as the ‘soft’ capacities that relate with personal and interpersonal competencies and aptitudes for resilience (Left-

hand quadrants). In table 3 below, various steps of the project are listed with the adaptive capacity the project sought to engage, related with a specific quadrant of the integral framework.

<b>Step</b>	<b>Description of Methodology and Activities</b>	<b>Adaptive Capacity Engaged</b>
Climate change impacts and local forest resource system vulnerability – biodiversity, hydrology and forested ecosystems		These technical studies related mostly with the Right-hand side of quadrants, particularly the <b>Lower Right quadrant of systems</b> .
Workshop on scenario planning: held with natural and social scientists, as well as a diverse range of concerned community leaders	Two day workshop in which participants learned of climate scenarios expected in the Northwest of BC and then participated in mapping four scenarios, according to two axis of climate change and peak oil	This process recognized that future histories are hard to conceptualize for most people, since they exceed the time span that the average adult mindset operates with. Such an activity assisted participants in imagining time envelopes that are broader than what they normally conceive of, thus building adaptive capacity in the <b>Upper Left quadrant of awareness</b> . It also built adaptive capacity in the <b>Lower Left quadrant of culture</b> , by creating a process to dialogue about these complex issues that can be depressing when considered in isolation without group support. Finally, the process was also designed to build adaptive capacity in the <b>Upper Right quadrant of behaviours</b> , in terms of participants considering what skills and aptitudes would be need for different scenarios and for using this information to strategize for policy change ( <b>Lower Right quadrant of systems</b> ).
Workshop on sustainable livelihoods: setting the stage, inviting interiors	Introductory process in which participants discussed <i>how</i> they wanted to engage together in the workshop.	This involved developing some guiding principles for dialogue and group engagement, and was relevant to developing adaptive capacity in the <b>Left-hand quadrants of awareness and culture</b> , namely how to have inclusive, respectful, and pragmatic conversations about adaptation.

Step	Description of Methodology and Activities	Adaptive Capacity Engaged
Workshop on sustainable livelihoods: Learning about how past people's responded to turbulent change.	Provided information and context regarding the consistent adaptation of past peoples to environmental change.	Looking at the anthropological data and retrieving the stories of past peoples' ways of responding to turbulent change encouraged participants to extend their thinking further back in time, so to better prepare for future histories. This section of the workshop facilitated adaptive capacity in the <b>Lower Left quadrant of culture</b> .
Workshop on sustainable livelihoods: self-inquiry into participant's own past peoples.	In small groups, participants reflected on their own family histories and past peoples, drawing on stories of how they or their ancestors survived rapid or unexpected changes.	This exercise intentionally encouraged participants to recall stories of resilience from within themselves and their family lineages. This is a mainstream use of a psychological tool, which encourages participants to take the perspective of earlier times to disclose important information for their present moment. It supports adaptive capacity in the <b>Upper Left quadrant of awareness</b> , as well as built trust and interpersonal adaptive capacity between participants ( <b>Lower Left quadrant of culture</b> ).
Workshop on sustainable livelihoods: Exploring climate change impacts and possibilities for community resilience	Pedagogical design included an intentionally diverse group of natural and social scientists, self-reflection and small group work to brainstorm further detail on the climate change impacts that are expected for this region, and then in a collaborative manner, drawing the possibilities for community resilience.	Hearing a presentation of scientific facts is a very different experience than discussing and building knowledge together on the expected climate change trajectories and how the community could best and most resiliently respond. Focusing on the latter, this activity emphasized the <b>Left-hand quadrants of awareness and culture</b> . Such as, by participants illustrating what a resilient community could look like, they used a different side of their brain that tends towards more qualitative descriptions and perhaps a more imaginative sense of the possible (UL). Then, bringing that into discussion engaged participants in interpersonal dialogue about resilience in a climate change context (LL).

**Table 3: Series of steps to assess local livelihoods sought to engage various modes of adaptive capacity within the research activities themselves, considering all four quadrants of the integral framework.**

### **5. Summary of livelihoods and impacts**

Based on the background vulnerability assessment (see 1 above) and the results of the workshop (see 3 above) the CRiSTAL spreadsheet was populated ([http://bvcentre.ca/files/research\\_reports/09-12CRiSTAL\\_BV\\_01Dec2011.xls](http://bvcentre.ca/files/research_reports/09-12CRiSTAL_BV_01Dec2011.xls)). The first module, climate and community livelihoods, captured the current climate context and identified the community assets. Based on the workshop three climate hazards were identified; fire, flooding, and global disruption of food supplies. Coping strategies were entered, such as fire proofing, re-forestation, increasing road culverts and greater reliance on local food. The climate hazards and community assets were cross-referenced identifying relative importance of each asset in managing the climate hazards. The tool provided a summary of the climate context, hazards, impacts and coping strategies, as well as a summary of the livelihood assets and their relative contribution to the climate hazard coping strategy.

For the second module, planning and management of a project, forestry and agriculture were used as case studies. For each project, the climate hazard was linked to the livelihood assets to inform a summary of the project and its reliance on specific assets and its vulnerability to climate hazards. The tool summarized each of the activities, the climate hazard and affected resources, the resources most important to coping, and the impact of the activity on the resource most important to coping.

### **Discussion**

A social-ecological framework for researching, understanding, and engaging climate change issues in British Columbia is fairly uncharted territory. It is not always possible to include natural and social scientists together on projects of this nature, let alone to include the more psychological dimensions of this issue. This project had several strong points as well as some key areas for improvement.

The project did succeed in bringing together natural and social scientists with the Integral theory framework providing a useful guide to understand and integrate the realms that different researchers exist within. Social-ecological systems theory, as with vulnerability assessments, includes an identification of adaptability as being an important component of the system. This project was able to identify some of the barriers to building adaptive capacity, namely the lack of recognition of the interior quadrants of the integral framework. As well, through an investigation of what assets were used in the past to deal with adversity, what the community still has, and what might be required to adapt to future events was helpful in identifying elements of what makes a community resilient to change. Further, social-ecological insights were gained by the participants in the scenario planning exercise where again resilience, adaptation options and possible transformation were explored.

The CRiSTAL spreadsheet tool was useful in organizing information on the current climate and asset context of the community. Using a community workshop to understand the possible risk and hazards of climate change helped connect the public to the assessment giving broader ownership over the results. The tool was structured to evaluate a specific project; this aspect was not as useful. The modifications done in the framing of current activities did provide some insights into adaptation options. However, the spreadsheet tool could be modified to be more relevant to evaluating existing community activities, and what adaptation options might exist in the future, including what assets would be required to adapt.

Another suggested improvement is to include ways to better evaluate the integral component of this project with greater rigor. For example, though the design of the project was to include the human dimensions of climate change, are there ways to more rigorously measure the effectiveness of doing this. Including methods for assessing shifts in awareness about climate change through, for example, quantifying the number of times certain themes were raised, assessing participants interpersonal capacity to engage together on discussing complex issues, and doing a pre and post assessment of participants 'sense of the possible' in terms of a resilient future in the face of climate change. Other possible evaluative tools could have tracked project outcomes over time, such as whether any social structure became established, such as a network or committee, or whether any policy change emerged from the process.

By far the more challenging dimension to evaluate is the Upper Left (UL) changes in awareness and self-identity. This quadrant essentially deals with *how people make meaning*, and thus their understandings, motivations, and self-identity that flow from that meaning-making. Changes in meaning-making can be assessed either qualitatively or quantitatively.

Qualitatively, this could be assessed with a pre and post interviews with a sample of the population on what extreme events people are aware of to assess whether and how they become more aware over time. That is, though a region may experience extensive flooding and a series of unpredictable weather events across several years, often people will explain them away as 'normal' rather than viewing them as part of a process of the climate changing. To really know what meaning people place on extreme events, one would have to actually carry out an interview or focus group to listen to how people interpret their views and experiences.

Quantitatively, changes in awareness can be measured through tracking evidence of new understandings on climate change in the media and in other social discourse (social media, radio stations, etc.) or through evidence of more adaptive behaviours that demonstrate a shift in awareness, such as an increase in practices like canning and preserving food, investing in environmentally-appropriate household upgrades, and transportation practices that cut down on carbon emissions.

Nevertheless, by including the human dimensions alongside the technical and scientific research, this project did carry a different quality of engagement for the community. While clearly on-going research is necessary to understand the current and future predictions on climate science, this cannot be the only

investment into understanding the issue. Often the scientific data alone is not enough; people need opportunities to digest that information in their own ways and at their own rate, talking amongst themselves about what it means in their lives. This is true in north-western B.C., and is all the more so in the regions of the world that are populated and impoverished, where education levels are lower and climate science can be misunderstood or disempowering to local communities if disconnected from the human dimensions of the issue.

To this extent, this project offers some key suggestions for how to include both interior and exterior dimensions of adaptation which may have relevance and usefulness in other communities and regions. These include:

***Designing with all quadrants in mind.*** Finding perhaps small yet meaningful ways to include the interior and exterior dimensions of the issue. This could be as simple as having a community workshop include didactic presentations from scientists, as well as moments for self-reflection and participatory group dialogue. Participants gain a more comprehensive understanding of the information by using these various modes of engagement.

***Bringing together natural and social scientists.*** This project sought to include an interdisciplinary team at the outset, including the project coordinator who was trained in social and ecological systems, an anthropologist with an applied understanding of the aboriginal context in the region, a social scientist familiar with integral theory as it relates to environmental issues, and a workshop facilitator particularly skilled in fostering personal reflection and participatory processes. Finding these intersection points between disciplines will increasingly be needed to conduct interdisciplinary (or in this case transdisciplinary) research for complex global issues like climate change.

***Aligning climate research as action research.*** This project sought to conduct climate research in such a way that communities' can then make use of the data for taking adaptive action. In other words, climate research that ends up only in published journal articles has a limited reach; by aligning climate research as *action research*, the very data becomes placed in service of communities' abilities to make use of it for building adaptive capacity and resilience. This inherently engages the scientific findings with cultural change, uniting both the exterior and interior dimensions, which could be useful in other communities and regions.

***Utilizing a comprehensive framework to unite and integrate perspectives.*** The Integral Theory framework was particularly beneficial for a project of this nature that sought to be transdisciplinary from the outset. Whether Integral Theory was applied implicitly by the project team to craft the overall project design, or whether it was used more explicitly to ensure workshop curriculum touched all relevant bases, it was useful in bringing disciplines together more synergistically. That does not only mean bringing science together with social science, but also means integrating facts with meaning, concepts with values, empirical observations with attitudes and motivations. The latter set of these pairs point directly to the human dimensions present in the climate change issue. Using Integral Theory

benefitted this project in being able to draw these human dimensions more directly into the research in ways that were rigorous—not as a holistic heap as may sometimes occur, but as a coordinated and integrated whole system framework. Other integrative frameworks could work in this similar way; this project used the Integral Theory framework mainly because of its combination of inclusivity and rigor and its focus on integrating methods, as well as its application in other projects and research on complex global issues.

## **Conclusion**

This report presented a community livelihood methodology and its application in north-western BC. A structured methodology is shown integrating sustainable livelihood and integral theory approaches in developing an assessment of livelihoods in the context of climate change in north-western BC. The main goal of this component of the broader multi-scale transdisciplinary project is to test methods to support adaptation of communities to climate change using the concept of sustainable livelihoods, augmented with integral theory. The methods tested included: climate change impacts and local forest resource system vulnerability; scenario planning; sustainable livelihoods assessment; application of Integral Theory to the Livelihood Assessment; and summary of livelihoods and impacts using the CRiSTAL spreadsheet tool. Testing these methods in a transdisciplinary approach, this project was able to identify some of the barriers to building adaptive capacity, namely the lack of recognition of the interior quadrants of the Integral Theory framework. This helps to explain why scientists, who tend to focus primarily on the objective, are often challenged with low public acceptance and lukewarm political response to the emerging climate science. The integration of these methods also demonstrates how other scientists and communities might seek a more comprehensive way forward with both further research and community engagement on climate change.

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**Appendix 1: Scenario Planning Workshop, scenario summaries.**

The scenarios presented consider factors that people have control over. Other things that cannot be controlled could be called "wild cards" which have not been directly added in to these scenarios. For example, global economic collapse, planetary dynamics were not considered.

<b>Drivers</b>	<b>T. Chaos</b>	<b>T. Design /polyanna</b>	<b>Hail Mary</b>	<b>Oh Frick!</b>
<b>CC</b>	5 change	1 change (due to design for sustainability)	1 change (due to innovations in sequestration)	5 change
<b>Oil</b>	Lots of oil, oil hogging	lots of oil	no oil	no oil
<b>Technology</b>	new tech	New technologies foster switch to non-fossil fuel based economies, increased energy conservation	New technology that sequesters CO2 in atmosphere; major sequestration technology; Fossil fuel powered carbon sequestration	no new technology
<b>Governance</b>	more participatory and enhanced democracy.	democracy	low democracy, top-down forced change	low democracy
<b>Locus of control</b>	regional; increase in local control, but decrease in global control	balanced between regional and global	global not regional	corporations, and governments backed by corporations.

<b>Drivers</b>	<b>T. Chaos</b>	<b>T. Design /polyanna</b>	<b>Hail Mary</b>	<b>Oh Frick!</b>
<b>CC</b>	5 change	1 change (due to design for sustainability)	1 change (due to innovations in sequestration)	5 change
<b>Oil</b>	Lots of oil, oil hogging	lots of oil	no oil	no oil
<b>Technology</b>	new tech	New technologies foster switch to non-fossil fuel based economies, increased energy conservation	New technology that sequesters CO2 in atmosphere; major sequestration technology; Fossil fuel powered carbon sequestration	no new technology
<b>Governance</b>	more participatory and enhanced democracy.	democracy	low democracy, top-down forced change	low democracy
<b>Locus of control</b>	regional; increase in local control, but decrease in global control	balanced between regional and global	global not regional	corporations, and governments backed by corporations.
<b>Global co-op</b>	global cooperation decreases, while increased regionalization of oil resources. Forced regional innovation	global cooperation; globalization still exists, but at a global scale, with agreements that kept temperature down. Implemented sequestration and adaptation technologies.	The world came together to reduce carbon emissions, but did so expending the planets oil reserves. This required massive sequestration	low global cooperation environmentally. Increase regionalization

<b>Drivers</b>	<b>T. Chaos</b>	<b>T. Design /polyanna</b>	<b>Hail Mary</b>	<b>Oh Frick!</b>
<b>CC</b>	5 change	1 change (due to design for sustainability)	1 change (due to innovations in sequestration)	5 change
<b>Oil</b>	Lots of oil, oil hogging	lots of oil	no oil	no oil
<b>Technology</b>	new tech	New technologies foster switch to non-fossil fuel based economies, increased energy conservation	New technology that sequesters CO2 in atmosphere; major sequestration technology; Fossil fuel powered carbon sequestration	no new technology
<b>Governance</b>	more participatory and enhanced democracy.	democracy	low democracy, top-down forced change	low democracy
<b>Locus of control</b>	regional; increase in local control, but decrease in global control	balanced between regional and global	global not regional	corporations, and governments backed by corporations.
<b>Global economy</b>	less corporatized, more regional, more about the city-states. Increase in tariffs.	healthy mix of cooperation and competition for innovations between companies. Functioning trade agreements.	highly corporatized. No tariffs.	highly corporatized globally. Mixed tariffs and international trade.

<b>Drivers</b>	<b>T. Chaos</b>	<b>T. Design /polyanna</b>	<b>Hail Mary</b>	<b>Oh Frick!</b>
<b>CC</b>	5 change	1 change (due to design for sustainability)	1 change (due to innovations in sequestration)	5 change
<b>Oil</b>	Lots of oil, oil hogging	lots of oil	no oil	no oil
<b>Technology</b>	new tech	New technologies foster switch to non-fossil fuel based economies, increased energy conservation	New technology that sequesters CO2 in atmosphere; major sequestration technology; Fossil fuel powered carbon sequestration	no new technology
<b>Governance</b>	more participatory and enhanced democracy.	democracy	low democracy, top-down forced change	low democracy
<b>Locus of control</b>	regional; increase in local control, but decrease in global control	balanced between regional and global	global not regional	corporations, and governments backed by corporations.
<b>Economic focus</b>	focus is around managing change (environmental and economic)	focus is around environmental sustainability	focus is consistent with what it is today (fossil fuel driven global profits and innovation for sequestration).	focus first was business as usual, and then focus shifted to economic survival, trying to maintain an economy (trade routes maintained, keeping afloat).
<b>Responses</b>	<b>T. Chaos</b>	<b>T. Design /polyanna</b>	<b>Hail Mary</b>	<b>Oh Frick!</b>

<b>Drivers</b>	<b>T. Chaos</b>	<b>T. Design /polyanna</b>	<b>Hail Mary</b>	<b>Oh Frick!</b>
<b>CC</b>	5 change	1 change (due to design for sustainability)	1 change (due to innovations in sequestration)	5 change
<b>Oil</b>	Lots of oil, oil hogging	lots of oil	no oil	no oil
<b>Technology</b>	new tech	New technologies foster switch to non-fossil fuel based economies, increased energy conservation	New technology that sequesters CO2 in atmosphere; major sequestration technology; Fossil fuel powered carbon sequestration	no new technology
<b>Governance</b>	more participatory and enhanced democracy.	democracy	low democracy, top-down forced change	low democracy
<b>Locus of control</b>	regional; increase in local control, but decrease in global control	balanced between regional and global	global not regional	corporations, and governments backed by corporations.
<b>ecological integrity</b>	moderately extreme ecological degradation	minor ecological degradation with the switch to green technology and sustainability	moderate degradation (since we spent the oil and tracked the landscape in oil pipelines) and then sequestered the carbon	very extreme ecological degradation

<b>Drivers</b>	<b>T. Chaos</b>	<b>T. Design /polyanna</b>	<b>Hail Mary</b>	<b>Oh Frick!</b>
<b>CC</b>	5 change	1 change (due to design for sustainability)	1 change (due to innovations in sequestration)	5 change
<b>Oil</b>	Lots of oil, oil hogging	lots of oil	no oil	no oil
<b>Technology</b>	new tech	New technologies foster switch to non-fossil fuel based economies, increased energy conservation	New technology that sequesters CO2 in atmosphere; major sequestration technology; Fossil fuel powered carbon sequestration	no new technology
<b>Governance</b>	more participatory and enhanced democracy.	democracy	low democracy, top-down forced change	low democracy
<b>Locus of control</b>	regional; increase in local control, but decrease in global control	balanced between regional and global	global not regional	corporations, and governments backed by corporations.
<b>food security</b>	Food shortage, local production; Reduced consumption of fossil fuels, increased reliance on local food production. Greenhousing. Using more technical solutions.	Local food production increases, less reliance on global food systems (and we say goodbye to bananas and coffee, with the exception of the elite)	still reliance global food systems	food shortages, variable local production, more instances of dramatic famine.
<b>climate migrants</b>	managed climate migrants	few climate migrants	few climate migrants	un-managed migration and random climate migrants.

<b>Drivers</b>	<b>T. Chaos</b>	<b>T. Design /polyanna</b>	<b>Hail Mary</b>	<b>Oh Frick!</b>
<b>CC</b>	5 change	1 change (due to design for sustainability)	1 change (due to innovations in sequestration)	5 change
<b>Oil</b>	Lots of oil, oil hogging	lots of oil	no oil	no oil
<b>Technology</b>	new tech	New technologies foster switch to non-fossil fuel based economies, increased energy conservation	New technology that sequesters CO2 in atmosphere; major sequestration technology; Fossil fuel powered carbon sequestration	no new technology
<b>Governance</b>	more participatory and enhanced democracy.	democracy	low democracy, top-down forced change	low democracy
<b>Locus of control</b>	regional; increase in local control, but decrease in global control	balanced between regional and global	global not regional	corporations, and governments backed by corporations.
<b>standard of living</b>	increased poverty, low employment.	high standard of living, and it's also equitable across the nations of the world.	global inequity and class inequity	extreme and inequitable poverty

<b>Drivers</b>	<b>T. Chaos</b>	<b>T. Design /polyanna</b>	<b>Hail Mary</b>	<b>Oh Frick!</b>
<b>CC</b>	5 change	1 change (due to design for sustainability)	1 change (due to innovations in sequestration)	5 change
<b>Oil</b>	Lots of oil, oil hogging	lots of oil	no oil	no oil
<b>Technology</b>	new tech	New technologies foster switch to non-fossil fuel based economies, increased energy conservation	New technology that sequesters CO2 in atmosphere; major sequestration technology; Fossil fuel powered carbon sequestration	no new technology
<b>Governance</b>	more participatory and enhanced democracy.	democracy	low democracy, top-down forced change	low democracy
<b>Locus of control</b>	regional; increase in local control, but decrease in global control	balanced between regional and global	global not regional	corporations, and governments backed by corporations.
<b>population level</b>	populations shifts and movement due to climate refugees, although they are managed. Conglomeration of local populations around remaining water and other agrarian sources. A bumpier ride for populations, people are dying off in certain regions, etc. (i.e. Somalia)	moderate population increase; with a more equitable society, better education, which corresponds with increasing reproductive age and declining birth dates.	high population, especially in current regions where population is already increasing.	massive population decline due to disease, climate related hazards, food insecurity, and all the rest of it.



<b>Drivers</b>	<b>T. Chaos</b>	<b>T. Design /polyanna</b>	<b>Hail Mary</b>	<b>Oh Frick!</b>
<b>CC</b>	5 change	1 change (due to design for sustainability)	1 change (due to innovations in sequestration)	5 change
<b>Oil</b>	Lots of oil, oil hogging	lots of oil	no oil	no oil
<b>Technology</b>	new tech	New technologies foster switch to non-fossil fuel based economies, increased energy conservation	New technology that sequesters CO2 in atmosphere; major sequestration technology; Fossil fuel powered carbon sequestration	no new technology
<b>Governance</b>	more participatory and enhanced democracy.	democracy	low democracy, top-down forced change	low democracy
<b>Locus of control</b>	regional; increase in local control, but decrease in global control	balanced between regional and global	global not regional	corporations, and governments backed by corporations.

## Appendix 2: Sustainable Livelihood Workshop Facilitators Agenda

### Bulkley Valley Research Centre

### Climate Change and Community Adaptation Workshop

Wednesday November 30<sup>th</sup>, 2011

#### The purpose of this workshop is to:

- Identify culturally specific adaptations to climate change
- List assets we currently have and assets we need to help us deal with climate change
- Become familiar with the risks created by climate change
- Learn from each others experience
- Build community dialogue, collaborations skills and our ability to address complex problems

#### Workshop Outcomes

- A methodology to help communities adapt to climate change
- Results that will be used to inform provincial and nation policy
- Network of active citizens

Agenda Item	Objective	Format
Welcome and share your name  45 min	Introduce organizers and facilitator  Explain how the day will roll out.  Help participants be curious about themselves and each other.	Rick/Don welcomes everyone and acknowledges traditional territory.  Shelley explains role of facilitator and introduce facilitation team, reviews session purpose and process. Asks permission to proceed hopes and expectations.  Each person answers as many questions as they can:

Agenda Item	Objective	Format
		<p>What is your full name?</p> <p>Who named you?</p> <p>What does your name mean?</p> <p>What is the history/ancestry of your name?</p> <p>Debrief:</p> <p>Explain: In order to build a community response we have to draw on all the ancestry, worldviews, insights from our individual selves to develop a collective wisdom.</p> <p>What did you learn from that activity?</p> <p>What is different from this introduction to one that presents information?</p>
<p>Working together</p> <p>15 min</p>	<p>Identify helpful ways to work together</p> <p>Agree upon how we can encourage effective dialogue.</p>	<p>Smalls groups brainstorm. Acknowledge Anne. Explain purpose/objective.</p> <p>Group 1</p> <p>If you ask thoughtful <b>questions</b> and listen openly to answers, you'll have real dialogue. What might this look like?</p> <p>Scoring points as an individual prevents good dialogue. <b>Collaborating</b> as a group open a much richer interchange. What might this look like?</p>

Agenda Item	Objective	Format
		<p>Group 2</p> <p>Debate is position based and polarizing. Dialogue is <b>interest focused</b> exploration and reflective. What might this look like?</p> <p><b>Trust</b> is the by- product of <b>respect</b>. It transforms complex problems into collaborative, solution - orientated outcomes. What might this look like?</p> <p>Group 3</p> <p>There is no front of the room in dialogue. <b>Equality</b> is encouraged among participants. What might this look like?</p> <p>Everything is <b>personal</b>. Probe someone’s values and personal experiences, and you’ll understand their stance on policies. What might this look like?</p> <p>Debrief:</p> <p>What did you notice?, So what is important about this? How will it help us be prepared for climate change? How will it help us today? What are you going to focus on today?</p> <p>Explain: Honing our ways of coming together to discuss dialogue and build knowledge will help us be better prepared for when we need this during times of crisis. (ie</p>

Agenda Item	Objective	Format
		climate change).
<p>Past peoples 45 min</p>	<p>Start thinking about how past peoples adapted to changes in the environment.</p>	<p>Rick does presentation.</p> <p>Don flips charts adaptations.</p> <p>Debrief:</p> <p>What squared with your beliefs?</p> <p>What questions are circling in your mind?</p> <p>What point caught your attention the most?</p> <p>What feelings emerged while listening?</p>
<p>Storytelling 1.5 hour</p>	<p>Pull out what we already know about climate adaptations.</p> <p>Identify assets we depended on in the past.</p>	<p>Individuals jot down notes on. A story from your family/ancestors when someone/some group or a community faced adversity from a climate event. How did they adapt to survive or thrive in that situation?</p> <p>Explain it can be a story from a long time ago or a story of how we are already adapting).</p> <p>Give 15 to take break, grab coffee and make notes</p> <p>Share your story with small group. Make a group list of adaptations.</p> <p>Don/Gail explains assets. Small group put on sticky notes assets that helped with the adaptation they discussed.</p>

Agenda Item	Objective	Format
		<p>Gail will facilitate clumping. Each group share 2 assets at a time and Gail will decide which column they belong in eg. Individual, social, financial, environmental, human, infrastructure.</p> <p>Debrief experience with large group. What do you notice? What did people learn? What is important about it?</p>
<p>Lunch 45 min</p>	<p>Nourish self</p>	<p>Lunch is ready to be eaten</p>
<p>Climate Future 30 min</p>	<p>Start thinking about what climate change research is suggesting</p>	<p>Don presents climate change impacts</p> <p>Debrief:</p> <p>In silence, close eyes and reflect on Don's presentation. What emotions came up for you, what kinds of feelings of resilience did you experience?</p> <p>What squared with your beliefs?</p> <p>What questions are circling in your mind?</p> <p>What point caught your attention the most?</p>
<p>Re-energize 5 min</p>	<p>Keep energy level up</p>	<p>Stretches.</p>
<p>What is going to happen? 45 min</p>	<p>Identify risks and hazards we will experience in the BV</p>	<p>Group draws a picture of the risks and hazards we will see in the BV in the next 20-50 years. Narrow down to 5. Share with large group. Votes on top by one dot most urgent and most assets required. Pick top 3.</p>

Agenda Item	Objective	Format
How to cope? 35min	Identify which resources/assets will help us cope.	<p>Large group identify which assets from past we no longer have.</p> <p>Gail explains quadrants and with large group put remaining past assets into quadrants. Small group come up with max 5 key new assets we have in each quadrant personal internal. Personal external, social internal, social external quadrants.</p>
Pulling it together 20 min	Determine how our resources/assets will help us address each risk	Carasol. Small groups look at list of assets and pick assets that help with risks. Rotate to different risks
What is missing 15 min	Identify gaps in resources.	Look at picture of risks and assets and large group discuss what assets will we need now that we have never needed previously in history.
Debrief 15 min	Share learning, questions, actions	<p>Each person shares</p> <p>Something they are taking away.</p> <p>Question they want to explore</p> <p>Point they want to act on.</p> <p>What common themes or collective messages do you see emerging?</p>

### **Appendix 3. Past Peoples**

A growing body of work in paleoanthropology is showing strong correlations between human evolutionary events and drastic and periodic changes in Old World climate over the past 3 million years. Such correlations include climate variability with an increase in brain size and major cultural developments, such as the invention of fire or adapting to a coastal marine diet. The study of past climatic changes is providing vital information about future evolutionary adaptations as humanity manages anthropogenic global warming. We have now entered the Anthropocene, a period in geologic time when human activity has had an impact on the Earth's climate and ecosystem (Vaidyanathan, 2010).

On a more recent and local scale, the indigenous populations of the Pacific Northwest have consistently occupied geologically and climatologically volatile landscapes for at least the last 12000 years. Such groups are profoundly connected to these places, and often adapt to and endure environmental change. Native populations maintain that proof of their long occupation in their traditional ethnographic territories is embedded in their oral traditions. These oral accounts are the primary methods for recording indigenous epistemology, history and cultural change. From a native perspective, references contained within oral traditions are factual.

Oral traditions that reference past catastrophic environmental events provide us with some perspective as to how past peoples adapted to environmental change. While there is a distinction between geological (volcanic eruptions, earthquakes, landslides) and climatic (flood, drought, wildfire, excessive snow and ice) environmental events, they are also intimately linked. Furthermore, from a human adaptation perspective, past peoples would have adapted to such environmental change in similar manners. Catastrophic geological events also cause climatic change.

The literature correlating paleoenvironmental events and native oral traditions is scarce. Reasons for the scarcity include epistemological differences between indigenous and western scientific paradigms, and difficulty in finding oral traditions that refer to such events. However, some research has been done (DeLaguna 1972, Budhwa 2002) relating specific catastrophic paleoenvironmental events and native oral traditions that refer to them, such as: (1) the Mount Mazama climactic (or 'caldera-forming') eruption, 6850 b.p.; and (2) the megathrust earthquake related tsunami of the Pacific Northwest, 300 b.p.. The historical literature pertaining to indigenous groups (specific to each event) was reviewed for oral traditions that may refer to the event in question. Through the use of qualitative and quantitative analysis, relationships between the geological and archaeological evidence and the event depicted in the oral tradition are shown to exist.

Geologically speaking, Mount Mazama (now known as Crater Lake) is a type of volcanic depression called a caldera (from Spanish for "cauldron"), formed by the collapse of the estimated 3,700m high Mount Mazama during that enormous eruption approximately 6850 b.p. (Fisher et al. 1997:46). That



climactic eruption of Mount Mazama followed a series of smaller events and significantly altered the immediate surrounding landscape. Pyroclastic flows devastated the surrounding area, including all of the river valleys that drained Mount Mazama to as far as 64 km away. The ashfall extended northeast of the volcano as far as Saskatchewan, Canada. Pumice and ash covered a total surface area of more than 2,600,000 km<sup>2</sup> at least 1 mm thick, and no less than 13,000 km<sup>2</sup> more than 15 cm thick (Williams and Goles 1968; U.S.G.S 2001). Rare particles of Mazama ash even have been found in ancient ice as far away as Greenland. Moreover, the ejected pumice and ash probably reached more than 30 kilometres high above Mount Mazama (Harris 1992:219). It is estimated that this cataclysmic eruption was at least 40 times greater than the A.D.1980 eruption of Mt. St. Helens. In other words, this was a catastrophic environmental event that would have profoundly affected the local Klamath people. In the Klamath account of this event, they sought immediate refuge in nearby lakes, only later to leave the area around Mount Mazama never to return. This is supported by a lack of geoarchaeological evidence in this region. Their adaptation is a logical response to an event that would have blanketed the landscape with volcanic ash and rendered it useless for an extended period of time. However, there would also have been an ideological component, which kept people away for generations even after the land was useable again. The sheer magnitude of the environmental event may have penetrated the cultural psyche of the Klamath keeping them from returning to that landscape.

Human history is also laced with examples of peoples interactions with tsunamis – which can be considered as violent, catastrophic surges of water that appear with little warning. The effect upon coastal populations can be devastating, as many people drown, and others suffer injuries after being caught up in the violently swirling floating debris. One relatively recent catastrophic example was the 1960 Chilean tsunami, where a massive subduction zone earthquake of magnitude 9.5 occurred off the coast of Chile, causing an immense tsunami to travel the entire Pacific Ocean until it reached the coast of Japan, 17,000 kms away, in approximately 10 hours, where it caused extensive damage and claimed 200 lives (Satake et al, 1995). Another recent tsunami event occurred in 2004 off the coast of Indonesia, which caused billions of dollars in damage and claimed over 230000 lives. It is one of the deadliest natural disasters in recorded history.

An historic example of coastal populations and a tsunami event occurred approximately 310 years ago, off the coast of Vancouver Island. This event was the result of a megathrust earthquake occurring within the Cascadia subduction zone. Archaeological evidence (Hutchinson and McMillan 1997; Minor and Grant 1996) suggests that several native village sites along the coasts of Washington State and Vancouver Island were abandoned during this time, likely as a result of earthquakes and related tsunamis. Evidence from these sites, such as drowned vegetation, waterlogged twined matting and various other cultural remnants, all indicate that the most recent subsidence within the Cascadia zone occurred 300 years ago (Atwater et al.1995a, Clague 1995, Clague and Bobrowsky 1994, Minor and Grant 1996, Hutchinson and McMillan 1997, Hyndman 1995, Satake et al., 1995). However, in all of these cited tsunami cases, people have returned to the area of impact, and continue to live there today. This may suggest that the abundant resources of the ocean combined with a preference for a coastal

marine diet outweighed the geological and climatic uncertainty. Although, this too may change as we continue to deplete oceanic resources.

Recent developments within scientific and political arenas suggest a need to examine human adaptation to climatic variability and change. The importance of adaptation in the climate change question is affirmed at all levels of resource management decision making, from local to international contexts. Yet, the current nature and processes of human adaptation to climate are poorly understood and rarely investigated directly. Moreover, human responses are simply assumed in impacts research. Analyses that do address adaptation use a variety of interpretations and perspectives, which often result in an incomplete and inconsistent understanding of human adaptation to environmental variations (Smithers 1998). An evaluation and use of the indigenous perspective within a western scientific framework may serve as a foundation for further work in this area. Eventually, a combination of the two perspectives may yield a richer, more holistic view of past peoples adaptations to environmental change, and inform us to better adapt to future environmental change.

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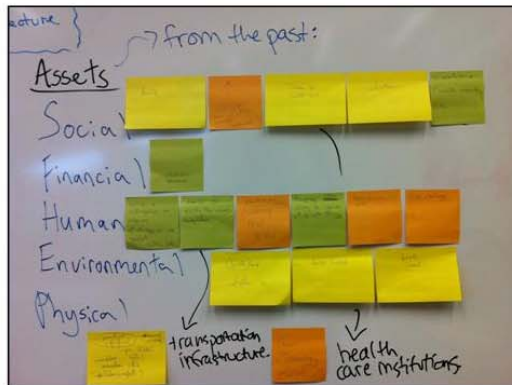
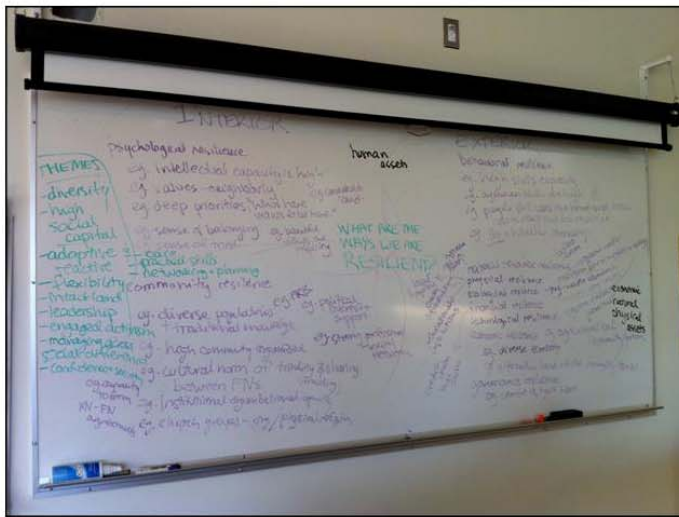
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Appendix 4: Photos







Participant Risk and Hazard Drawings