

CLIMATE CHANGE AND FIRST NATIONS SOUTH OF 60: IMPACTS, ADAPTATION, AND PRIORITIES

APPENDIX 3: IMPACTS AND ADAPTATION TABLES



Submitted To:
Indian and Northern Affairs Canada

Submitted By:



May 2008

Appendix 3

Impacts and Adaptations Tables

Table of Contents

1.0	INSTRUCTIONS FOR TABLES	1
2.0	ECOREGION MAP	2
3.0	IMPACTS AND ADAPTATIONS TABLES	3
3.1	Table 1 - Priority Impacts Identification & Pillars of Sustainability	3
3.2	Table 2 - Priority Impacts & Adaptations Brainstorming	9
3.3	Table 3 - Adaptation Strategies by Priority Impact.....	11

1.0 INSTRUCTIONS FOR TABLES

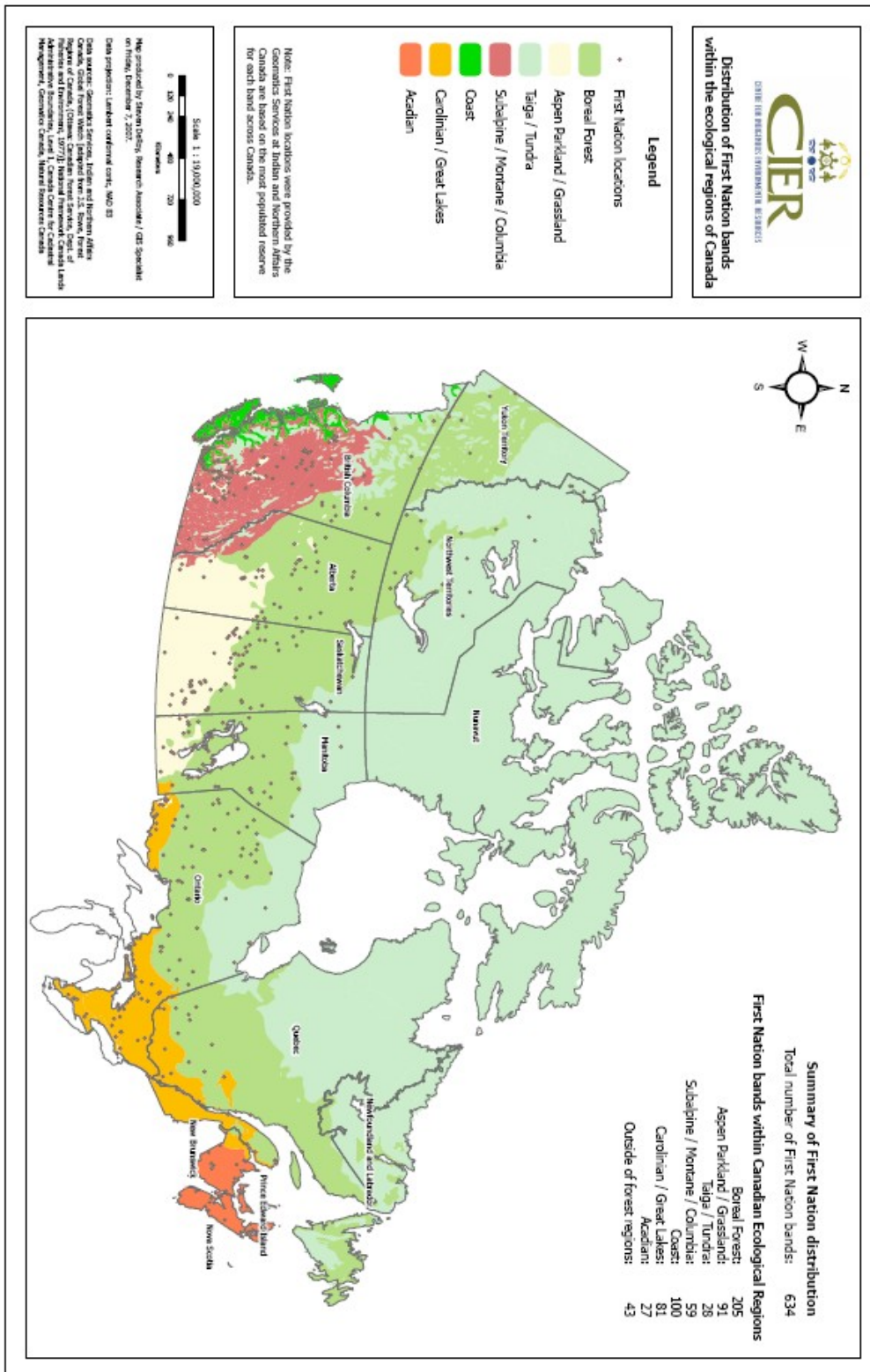
CIER utilized a large matrix to determine national climate change priorities and potential adaptation options. We modified this matrix into three tables that list a large number of potential impacts and corresponding adaptation strategies to facilitate community brainstorming of their priorities.

Use the following tables to start your adaptation planning process and determine your five most important climate change impacts and potential adaptations.

A map of the ecoregions is located in section 1.2 on the following page. Alternatively, access your provincial map located in Appendix 1 of the document titled: *Climate Change & First Nations South of 60: Impacts, Adaptations, and Priorities*. Make a note of the ecoregion within which your nation falls at the top of tables one and two.

- 1) Refer to table one, entitled "Impacts Brainstorming". Check off all of the impacts that apply to your nation.
- 2) For each 'check', indicate the pillars of sustainability affected by the impact. The four pillars of sustainability are cultural, economic, environmental, and social. When deciding if the impact affects each pillar of sustainability ask yourself the following:
 - Cultural: Will the Climate Change impact language, ceremonies, or traditional practices?
 - Economic: Will the Climate Change impact affect economic opportunity (positive or negatively), cost to the band administration, cost to the traditional economy or subsistence economy, or the cost of living?
 - Environmental: Will the Climate Change impact affect negatively or positively the physical environment (air, water, and land) or plants, animals, and insects?
 - Social: Will the Climate Change impact health, safety, recreation, or government?
- 3) Refer to table two entitled "Priority Impacts and Adaptations Brainstorming". Please circle your top five impacts from the list and give any examples of adaptations that you can think of.
- 4) Once you are finished brainstorming, or if you are having difficulties, refer to table 3 entitled "Adaptation Strategies by Priority Impact". This table lists adaptation strategies described in literature or identified through our research.

2.0 ECOREGION MAP



3.0 IMPACTS AND ADAPTATIONS TABLES

3.1 TABLE 1 - PRIORITY IMPACTS IDENTIFICATION & PILLARS OF SUSTAINABILITY

Priority Impacts Identification and Pillars of Sustainability		
Ecoregions: Boreal (B), Aspen Parkland (AP), Taiga (T), Subalpine (S), Coast (C), Great Lakes (GL), Acadian (A)	1. What is your ecoregion? _____	
Impacts: Climate change impacts are the environmental changes that are currently happening or predicted to occur due to global climate change.	2. Check "Yes" for each impact relevant to your community.	
Pillars of Sustainability: Economic (E) (cost of living, administration, economic opportunities, traditional economies), Environmental (EN) (negative, physical: plants, animals, air, water, land), Social (health, safety, recreation, governance), Cultural (C) (language, ceremonies).	3. For each "Yes", indicate which pillar of sustainability it affects. Use abbreviations.	
Impacts	Yes	Pillars of Sustainability
Water		
Water - Glaciers		
Receding/increased melt rate		
Spring Flooding		
Advancing (some regions - West Side of Mountain Ranges)		
Surface and ground water reduction east of Mountain Ranges (Drought)		
Aesthetics		
Water - Surface		
Deteriorating quality		
Lower quantities		
Higher quantities		
Overland flooding		
Decreased oxygen levels		
Increased sedimentation		
Concentration of existing pollutants		
Increased evaporation		
Disappearing lakes		
Changing waterways - rivers		
Flash flooding		
Changing water velocities		
Increased temperature		
Water expansion due to heating		
Long off ice season/open water season		

Impacts	Yes	Pillars of Sustainability
Changing lake turnover		
Changing lake stratification		
Increase algae blooms		
Changes to waves		
Changes to currents		
Drying wetlands bogs, fens		
Increased bog fires		
Storm surge		
Increased precipitation		
Extreme weather events		
Changes to artesian wells		
Increased waterborne diseases		
Increased standing water		
Groundwater		
Changes in recharge - glaciers, surface water, increased run off		
Decreasing quantity/decreasing availability		
Changing groundwater flow		
Decrease in quality from overland flooding, melting permafrost		
Land		
Melting permafrost		
Increased forest fires		
Increased forest damage (wind)		
Loss of drought-intolerant tree species		
Changing forest structure		
Increased evapotranspiration		
Moving treeline/timberline		
Shrinking region (tundra/taiga)		
Changing boundaries (latitude/altitude)		
Longer thawed surface for tundra and taiga		
Increased erosion (wind, water)		
Drying soils		
Increased landslides		
Increased avalanches		
Changes in snow depth/quantity		
Aesthetics		

Impacts	Yes	Pillars of Sustainability
Changes in annual patterns of precipitation		
Changes in seasonal patterns of precipitation		
Drought		
Drying watershed		
Flooding		
Storm surges		
Salinization of soils		
Desertification		
Increased shoreline (receding water)		
Loss of land - sea level rise		
Loss of land - erosion		
Loss of land - surface water flooding		
Loss of beaches (floods/receding water/erosion)		
Increased wind/wind storms		
Ice storms		
Hurricanes		
Ice storms		
Changing harbours		
Storm surges/flooding/sea level rise damaging deltas/Estuaries/salt flats		
Tides changing		
Changes in productivity		
Increased annual temperatures		
Animals		
All		
Loss of native species from invasive species (all animals)		
Inverts		
Forest Infestations from Pests		
Pine Beetles		
Spruce Beetle		
Forest Tent Caterpillar		
Spruce Budworm		
Asian Longhorn Beetle		
Expanding ranges into the Arctic		
Increasing population of disease vectors		
More black flies		

Impacts	Yes	Pillars of Sustainability
More parasites (What parasites? Human, mammals, or aquatic)		
Crop pests increasing		
Birds		
Changes to migration routes		
Changes to critical habitats		
Changing populations of wetland species		
Changing dickie bird ranges / seasons		
Vertebrates		
Changes in behaviour (hibernations, migration, ranges)		
Increased stress from pests		
Habitat changes		
Heat stress		
Increased competition		
Increased exposure to disease		
Change ecological niches		
Reduced Fur Quality		
Decreased Health		
Extinction		
Mass death due to changes in ice safety		
Aquatic		
Loss of species (invasive, temp changes, increased pollutant conc.)		
Increased in deformities		
Increased feminization (temperature dependent sex determination)		
Spawning changes		
Water changes affecting sex ratios		
Keystone species reduction (Marine, Aquatic, Animals)		
Changes in aquatic mammals species		
Marine		
Changes in seafood		
Changes in shell fish		
Changes to coral		
Changes in ranges of small and large marine animals		
Changes in food chain		
Changes in ooligan		
Changes in marine fish species		

Impacts	Yes	Pillars of Sustainability
Plants		
Changes in distribution		
Changes in forest ranges		
Drying of berries		
Drying moss		
Changes in phenology		
Invasive plant species / increased competition		
Increase size of plants		
Extended growing seasons		
Changes in productivity - increase/decreases		
Increased stress resulting from pests		
Loss of drought-sensitive plant species		
Loss of shoreline species		
Shoreline erosion		
Sensitive habitat loss - costal erosion, wetlands		
Increased disease		
Fires		
Increasing bog fires		
Pollination/Seed transport loss due to changing vector timing		
Effects on fruit trees		
Changes in amount of medicine in plants		
Increased evapotranspiration		
Change in community structure		
Increased wind throw/blow down		
Aesthetics		
Increased pollen		
Weather		
Extreme Weather Events		
Increase in frequencies of extreme weather		
Increase frequencies/severity of storms; including thunder, and wind		
Increase frequencies/severity of hurricane		
Increased frequencies/severity of tornados		
Increased frequencies/severity of snow storms		
Increased frequencies/severity of hailstorms		
Increased frequencies/severity of ice storms		

Impacts	Yes	Pillars of Sustainability
General Weather		
Changing precipitation seasonal/annual		
Increased frequencies/severity of heat waves		
Shorter, milder winters		
Longer, hotter summers		
Increased global temperature		
Regional cooling possible		
Changing wind speeds - seasonal/annual		
Changes in cloud cover - seasonal/annual		
Increased lightning and thunderstorms		
Fewer extreme cold events		
Increased variability		
Straight line winds		
Increased humidity		
Increased freeze thaw cycle		
Rapid thaw leading to flooding		
Changes in snow structure		
Air		
Increasing temperature/ increased humidity		
Exacerbates compounds - smog		
Increased particulates - drier conditions combined with wind		
Changing air patterns/jet streams		

3.2 TABLE 2 - PRIORITY IMPACTS & ADAPTATIONS BRAINSTORMING

Priority Impacts and Adaptation Brainstorming	
1. Identify your ecoregion: _____	Ecoregions: Boreal (B), Aspen Parkland (AP), Taiga (T), Subalpine (S), Coast (C), Great Lakes (GL), Acadian (A)
2. Circle your top five impacts from the following list.	
3. Identify adaptation strategies for each of the five impacts selected.	
Impacts	Adaptation Strategies
Water - Surface	
Receding/increased melt rate of glaciers	
Deteriorating quality	
Overland flooding	
Increased sedimentation	
Increased temperature	
Storm surge	
Increased waterborne diseases	
Land	
Increased forest fires	
Changing boundaries (latitude/altitude)	
Changes in snow depth/quantity/quality	
Drying watershed	
Animals - Inverts	
Forest Infestations from Pests	
Increasing population of disease vectors	
More parasites	
Animals - Birds	
Changes to migration routes	
Changes to critical habitats	
Animals - Vertebrates	
Changes in behaviour (hibernations, migration, ranges)	
Increased stress from pests	
Increased exposure to disease	
Animals - Aquatic	
Spawning changes	
Keystone species reduction (Marine, Aquatic, Animals)	

Impacts	Adaptation Strategies
Animals - Marine	
Changes in seafood and shell fish	
Changes in ranges of small and large marine animals	
Changes in marine fish species	
Plants	
Changes in forest ranges	
Increased disease	
Weather - Extreme weather events	
Increase in frequencies of extreme weather	
Increased frequencies / severity of snow storms	
Weather - General Weather	
Shorter, milder winters	
Longer, hotter summers	
Fewer extreme cold events	
Rapid thaw leading to flooding	
Air	
Exacerbates compounds - smog	

3.3 TABLE 3 - ADAPTATION STRATEGIES BY PRIORITY IMPACT

Potential Adaptation Strategies (as suggested in literature or existing adaptation projects) by Priority Impact
Deteriorating/Changing Water Quality and Quantity
Establishing and using water regulating structures to maintain flow rates of rivers
Change in the parameters of water treatment or the introduction of different or improved technologies
Improving demand management to decrease total water consumption through water conservation initiatives and water-costing mechanisms; water conservation measures and public education programs; water conservation through consumer education (restricted lawn watering, xeriscaping, low flush toilets/showerheads), industrial and commercial re-use of water, upgrading plumbing infrastructure, implementing charges for water
Pay farmers and landowners to maintain/enhance wetlands, ecologically sensitive lands, riparian areas, and natural areas
Relocating water intakes
Digging deeper wells or getting a surface water supply from further away
Boil water advisories
National (federal-provincial) monitoring efforts
Increased effort at water quality protection from agricultural, industrial and human wastes
Water management options such as reservoir development habitat protection
Protecting and re-vegetating riparian zones (reduce damages and losses from flooding), increase water retention in wetlands, restore or maintain connects between wetlands and lakes or rivers [<i>and groundwater</i>]
Wetland conservation - establish policies which protect wetlands since wetlands are beneficial for their ability to provide water purification
Improved planning and preparedness for droughts and severe floods
Networking with other communities
Taking bottled water out on the land / Use snow instead of lake water for drinking when on the land
Small dams to help control flow rates for community based hydro; increase industrial reclamation standards (longer-term WQM and potable water standards. Communication; Education and training, retrofit First Nation sewage systems to handle warmer climates/warmer source water; distribute and plan to meet water quality guidelines, where possible use watershed approach to source water protection. Protect cold groundwater input to deal with warmer water impacts on salmonid fish; create river drainage systems to handle increase in river flow; rain water capture.

Increase in Frequency and Severity of Extreme Weather
Land management - avoid building on land prone to flooding, erosion and violent winds; future land use decisions enforced through policies and bylaws; re-examination of plan policies, zoning controls, sub-division regulations, and building by-laws
Redefining construction standards for zoning, planning and building codes; for infrastructure and/or using protective works i.e. Red River floodway; structural adaptations enforced through building and engineering codes
Construction of protective engineering works such as ripraps, breakwaters, levees, bulkheads, (but are expensive and often shield erosion zones to the detriment of bordering zones)
Improving weather forecasting to allow earlier weather alerts and greater accessibility to regional-specific weather forecasts; community communication networks; reopening recently closed weather monitoring stations (provide up-to-date weather reports)
Creating or updating emergency response plans/ preparedness plans, or warning systems; land use planning
Building a network of cabins to provide shelter and safety for those hunters and travellers who get caught in extreme weather events (position cabins along travel or hunting routes)
Buying bigger and faster boats with GPS
Moving buildings and infrastructure out of flood prone areas
Droughts - soil moisture conservation strategies, promoting the recharge of aquifers, construction of farm ponds and dugouts, designing new criteria for adjustable water storage structures
Installation of a tertiary waste-water treatment; addition of a second larger water pipeline from nearby lake; xeriscaping; when dry use wells
Increase insurance and/or public relief
Cloud Seeding (prevent hail, increase precipitation)
Install storm water retention ponds at critical points in the storm drainage network to deal with extreme rain
Changing the National Building Code of Canada to prevent or decrease damage to buildings
Install storm-water detention tanks for more ponds at critical ponds in the system for untreated waste water runoff from high rainfall events, treat this excess water; use silt fences, tarping soil and fill stockpiles to help minimize damage from storms.
Consider the entire potential range of rainfall events when planning water treatment systems, to allow for maximum infiltration during the low intensity rainfall events, coupled with maximum storage for the high intensity events

Dyke and diversion system support from sandbagging and extending dykes; research and education (flood hotline, Red River Basin Task Force); establish floodplain construction requirements in the National Building Code
Silt fences, tarping soil and fill stockpiles to help minimize damage from storms.
Building treatments such as increased use of "hurricane brackets" to hold roof in place; Building treatments such as increased strength of windows (low-e argon windows, for example which are cited as having additional strength to withstand wind)
Emergency preparedness planning
Installation of an Emergency Public Warning System and creation of an Emergency Response Communication Centre
Diversification of natural resources used in local economy
Adopt larger and more powerful sea-worthy boats and snowmobiles for harvesting and transportation purposes (more expensive too)
Secure energy source, and back-up services (e.g. diesel, sat. phones); shared emergency response/clean-up equipment (e.g. TC)
Community based hazards mapping; INAC to pay for damage to infrastructure from storms within impacts to Band Capital Programs; Melting permafrost in North - study soil in North in newly thawed permafrost to determine increased capacity to support agricultural practises
Changes in the Behaviour of Species / Loss of Keystone Species
Establishing and using water regulating structures to protect the spawning grounds of fish species
Habitat or species preservation; migration corridors; minimize landscape fragmentation, preserve or restore migration corridors; increased connectivity between habitats
Establishment of reserves or refuges for animals
Address climate change in species-at-risk recovery plans
Account for climate change in (forest management) habitat management plans
Encourage active habitat management, such as the establishments of nest boxes and the protection of cavity trees, to facilitate the colonization of sites by bird species expanding their ranges.
Consider translocation of sensitive species farther north if inadequate habitat connectivity is blocking the species distribution
In severe cases, establish captive populations of rare species to conserve genetic diversity
Adjust harvest allocations and seasons of (hunted and trapped) wildlife species to reflect changing carrying capacities and shifting breeding and migration patterns

Review of the regulations governing fishing; developing aquaculture facilities; changing laws for sport fishing to catch-and-release only; change fishing quotas to total allowable harvest; new regulations decreasing allowable catch for commercial Freshwater and Saltwater fisheries; review of expected subsistence levels for First Nation people; Changes to current commercial fisheries management systems (e.g. laws on sport fishing changed to catch and release only); Moratorium on some fishing (e.g. lake trout)

Animal monitoring programs

Modifying the timing of harvest activity (get winter wood in spring instead of fall), modifying the location of harvest activity, modifying the method of harvesting activity (go on ATV instead of skidoos), adjusting the species harvested, minimizing risk and uncertainty (don't go if too dangerous)

Share wild foods with community members (Elders, disabled people)

Use of 'fire smart' landscapes; implement fire smart programs

Improve soil management, spacing, tree rotation length to enhance success of forests under new or variable climate patterns

Improved density control in both natural and artificial regeneration

Create biologically diverse rather than single-species tree plantations to enhance and hasten species dispersal to more suitable new ranges

Develop relationships with nearby FNs if need to move into their territory; economic diversification (community level; individual business); adapt to new hunting/trapping/fishing species.; have a communal freezer/food co-op; get involved in bioregional planning;

Develop community health plan to address shift from traditional foods (decreased keystone species) to market/commercial foods to ensure 'healthful' market foods are affordable and accessible; halt major projects in the north; don't punish north because of loss in south, any habitat reserves should be in south; animal strategies subject to Aboriginal and treaty rights

Increase in Forest Fires

Programmes of multiple thinning before final harvest

Breeding programmes that attempt to improve the desirable traits of species to be regenerated

Preserve diversity within gene pool of trees

Develop systems of protection from fire, insects and disease

Silvicultural measures such as artificial regeneration, thinning, or fertilization; pest management

Inventory and forecasting tools for planning and scheduling of forest interventions

Transition from fire prevention to fire management; Natural Disturbance Based fire management (controlled burns)

Traditional management, agro forestry, small woodlot management and windrow (shelterbelts)
Substituting existing recreational sites for different areas
Shifting species and genetic varieties of trees to increase water use efficiency in trees
Invest more in prevention, management and containment of large forest fires
Develop emergency preparedness plan/evacuation plan; public education; change in fires season readiness; identifying vulnerable infrastructure and measures to protect; Ensure there is dual entry/access to community; Build fire breaks around community; Have a forest fire training/local crew; sufficient/operable/local water source/pumps/trucks/respirators; Fire monitoring to identify vulnerable areas; Increase (or get) insurance
Restoration projects funded by voluntary 'carbon offsets' markets; research and monitoring programs; economic programs (create mills and sill lumber, burn stands, replant), create new economic opportunities using infested wood; fire smart; work with shifting forests and plant broad leaf trees in southern regions, plant shrubs and other plants to prevent erosion;
Changes to Snow / Ice Due to Warmer Weather
Construction of all season roads; moving winter roads onto land instead of over rivers and lakes; changing coastal routes of winter roads
Increased reliance on barge transport in the summer
More expensive construction and maintenance of ice-roads that would extend their seasonal life e.g. construction of permanent stream crossings
Use airships to transport goods; fly in supplies
Other innovations (e.g. using balloons to transport oilfield equipment over ice roads)
Development of land camps to strengthen TK, maintain skills and values
Develop community communication networks (hazards mapping; mapping out/monitoring community trails and communicating to citizens which trails are safe, etc)
Adjustments in hunting timing, methods and management regimes
Rely on more low-impact transportation systems
Be flexible, take more time when planning, wait
Take extra supplies, becoming more risk averse (avoiding dangerous areas, avoiding going out if the weather is going to be bad, avoiding travel at dangerous times of the year), technological adjustments (use of GPS, vhf radios, satellite images of ice) and use of better equipment (powerful boats), changing the timing and location of harvesting, community networking (where to go, when); resource collection close to home

General
Environmental monitoring
Education and awareness about Climate Change
Implement sustainable living practises
Informal networks - informal organizations, local band councils, scientists and ecologists, municipal governments working together to develop resource management techniques and long-term strategic planning
Pilot programs, aimed at building adaptive capacity in the 'worst case scenario' and amongst the most vulnerable/poorest communities (can then be used by higher capacity First Nations
Build adaptive capacity by developing incentives to promote adaptive behaviour (and disincentives to maladaptive behaviour (coordinating with federal/provincial governments)
Use Risk Management Approach in community decision making; ecological economics (full cost accounting for not adapting)