COST—BENEFIT ANALYSIS OF THE RISKS OF COASTAL FLOODING AND EROSION ON INFRASTRUCTURE AND PROPERTIES AT TRACADIE HARBOUR, PE

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DV8 CONSULTING, on behalf of Department of Communities, Land and Environment
Using cost-benefit analysis to evaluate climate change adaptation options in Atlantic Canada (ACASA, 2016)

Case Study Locations:
- Chignecto Isthmus, NS & NB
- Halifax Harbour, NS
- North Cape Coastal Drive, PE
- Tracadie Harbour, PE
- Marystown, NL
- Bay Bulls–Witless Bay, NL
A CBA is a tool to evaluate the strengths and weaknesses of various decisions or policies (i.e., adaptation options).

CBA Goals:

1. To determine the *feasibility* of different options.
2. To provide a *common basis for comparison* between competing options.

Example: Shoreline stabilization using Island stone vs armour stone – different up front costs, but also different lifespan or maintenance.
Contributors and Stakeholders:

UPEI Climate Research Lab;
St. Francis Xavier University;
PEI Department of Transportation, Infrastructure and Energy;
PEI Department of Communities, Land and Environment;
PEI Department of Economic Development and Tourism;
PEI Department of Agriculture and Fisheries;
PEI Department of Finance;
Public Works and Government Services Canada;
Department of Fisheries and Oceans Canada;
Maritime Electric; and
Bell Aliant
Points of Interest:
- Tracadie Small Craft Harbour
- Public beach
- Residential (seasonal) properties

Coastline Classification:
- Wetland estuary (55%)
- Sand dune coast (23%)
- Wetland coast (10%)
- Low plain estuary (7%)
- Bluff estuary (3%)
- Sand dune estuary (1%)
Coastal infrastructure at risk:
- Properties (land) – value based on property assessment
- Buildings/Houses – value based on property assessment
- Roads and utility lines – value based on construction and/or replacement costs
- Tracadie Harbour Assets and Infrastructure – harbour asset inventory
Coastal Flood Risk – Sea Level Rise and Storm Surge Events

Flood risk damage was evaluated for 16 cases: a 1-in-10, 1-in-25, 1-in-50 and 1-in-100 year storm events, occurring in each 2010, 2040, 2060 and 2070; and further linearly interpolated to evaluate annual risks.

Infrastructure at risk includes:
- Tracadie Harbour—buildings/infrastructure
- Wharf Rd and Beach Rd
- 4 residential homes with direct impact; additional properties are impacted due to lost access.
Historic erosion and accretion rates were used to project to determine the new coastline for each decade (2010, 2020, 2030... 2100), and risks associated with erosion were interpolated annually.

High Vulnerabilities:
• Wharf Rd (current strategy is to use Island Sandstone for shoreline stabilization along the road)
<table>
<thead>
<tr>
<th>Description of Option</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Short term (current strategy)</strong></td>
</tr>
</tbody>
</table>
| **Private properties:** Repair as necessary after a storm surge event.  
**Roads/Utilities:** do nothing with secondary roads; maintain hard protection of Harbour Rd with Island Stone.  
**Harbour Infrastructure:** repair to previous condition after flood events |
| **2. Mid-range** |
| **Private properties:** Build dykes to protect private properties from flood events with Island stone protection from erosion.  
**Roads/Utilities:** do nothing with secondary roads; use hard protection of armour stone for Harbour Rd.  
**Harbour Infrastructure:** raise buildings and infrastructure |
| **3. Long term** |
| **Private properties:** Raise or relocate buildings on private properties.  
**Roads/Utilities:** raise secondary roads to act as dykes and to maintain access; raise Harbour Rd to prevent flooding and use hard protection of armour stone for erosion protection.  
**Harbour Infrastructure:** raise buildings and infrastructure |
| **4. Close the wharf; protect private properties** |
| **Private properties:** Raise or relocate buildings on private properties.  
**Roads/Utilities:** do nothing with secondary roads; do not protect or rebuild Harbour Rd  
**Harbour Infrastructure:** do not rebuild; invest in nearby facility and relocate fisherman (mussel fisherman require new boats for transport alongshore outside of harbour) |
| **5. Close the wharf; relocate private properties** |
| **Private properties:** Relocate buildings to new properties (adds cost of land acquisition)  
**Roads/Utilities:** do nothing with secondary roads; do not protect or rebuild Harbour Rd  
**Harbour Infrastructure:** do not rebuild; invest in nearby facility and relocate fisherman (mussel fisherman require new boats for transport alongshore outside of harbour) |
### CBA Results:

<table>
<thead>
<tr>
<th>Adaptation Scenarios</th>
<th>Net Present Value (NPV) with a 4% discount rate</th>
<th>Benefit-Cost Ratio (BCR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Short term solution <em>(current strategy)</em></td>
<td>- $1,364,655</td>
<td>0.06</td>
</tr>
<tr>
<td>2. Mid-range solution</td>
<td>- $1,642,622</td>
<td>0.40</td>
</tr>
<tr>
<td>4. Long term solution</td>
<td>- $637,667</td>
<td>0.63</td>
</tr>
<tr>
<td>5. Close the wharf; protect the private property</td>
<td>- $2,176,714</td>
<td>0.34</td>
</tr>
<tr>
<td>6. Close the wharf; relocate the residents</td>
<td>- $2,224,714</td>
<td>0.33</td>
</tr>
</tbody>
</table>

Initial results found that none of five scenarios were profitable or cost-effective. By adding additional variables to the “costs” (such as the fisheries landings) the results were forced positive but remained consistent in ranking the scenarios.

**NPV** – An option is considered profitable when NPV is positive; when comparing different options the highest NPV is the considered the most profitable.

**BCR** – represents the “bang-for-your-buck”; the option is cost-effective if BCR is greater than 1.0; the option with the highest BCR is considered the most desirable.
Lessons Learned:

1. For this case study, it is more beneficial to protect the road and infrastructure than to close the wharf and relocate the fisherman. HOWEVER, that will not always the case.

The CBA methodology is recommended as an analytic tool for evaluating multiple small craft harbours, for:

- Establishing priorities for investment,
- Identifying locations where resources can be consolidated, and
- Succession planning
Lessons Learned:

2. The most profitable adaptation option was identified as the *long term solution* (higher up front costs; reduced maintenance over time):
   - Raise and/or relocate buildings on private properties;
   - Raise roads to maintain excess to properties during storm event;
   - Raise infrastructure and buildings on the wharf.
Lessons Learned:

3. The aquaculture industry was found to be inherently resilient to the projected impacts associated with sea level rise and erosion.

The concerns expressed by this stakeholder group were related to other climate change influences such as:
- Changes in sea ice cover
- Changes in water temperature
Thank you

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