Estimating Adaptation Costs and Benefits: How Much do We Know?

By

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I want to raise 5 questions

• How well do we understand the magnitude of adaptation costs at the individual project level?
• How much information do we have on the breadth of adaptation needs?
• Have extreme events been well addressed?
• How well have we separated out no regrets adaptations from climate change induced adaptations?
• How well do we understand how effective adaptation will be?
How We’ve Tended to Estimate Adaptation Costs

• Typically “top down” approaches
  – Start w/ climate change scenarios
  – Focus on change in average conditions
  – Little focus on adaptation

• Models applied to nations or world
  – Similar and simplifying assumptions
  – Good for first order estimates

• % increase in investment, e.g., World Bank, UNFCCC
Problems w/ Current Approach

• (at least) three problems;
  – Miss many site-specific heterogeneities and complexities
  – May leave out many important impacts
  – Not address extreme events
1. Few Impacts Studies Estimate Adaptation Costs

- Sea level studies address costs of protection
- But,
  - Agriculture focuses on changes in production and net welfare
  - Water studies focus on change in supply
  - Health studies focus on additional cases
  - etc., etc.,
- The literature has focused on estimating damages, not splitting out adaptation costs
The UNFCCC Study

- Attempted to estimate costs of adaptation in a number of sectors
- Simple bottom assumptions in a few sectors: costs of specific adaptations
  - Water resources
  - Coastal resources
  - Human health
- Top down approaches: % of current investment
  - Agriculture
  - Infrastructure
- Estimates may not have right order of magnitude
Are Some Interesting Case Studies That Give Some Insight on the Relative Magnitude of Adaptation Costs
Kirshen et al. (2006): Metro Boston Adaptation Costs

- Water Quality Treatment
  - Assabet River
  - Up to 50% increase in capital and annual O&M for DO and NPS by 2050

- SLR: Adaptation about ½ of current flood damages (in 2100)
  - The most cost-effective outcome

- USEPA estimates $100B in baseline investment needs for water quality in US alone
Adapting Alaskan Infrastructure

- Larsen et al. In Press. GEC
- Adapting to impacts of permafrost melting on infrastructure
- Data base: 16,000 infrastructure pieces
- Climate change add + 10-20% by 2030; + 10% by 2080
2. Breadth of Adaptation Needs

- In estimating adaptation costs, we’ve tended to rely on studies of a few sectors
  - The main purpose of those studies has typically been to estimate impacts or damages
- A lot of sectors have not been studied and many important aspects of adaptation in studied sectors has not been addressed
Key Adaptation Not Addressed in Some Studied Sectors, e.g.,

- Water Resources
  - Costs of infrastructure
  - Water quality impacts and treatment costs
  - Flood impacts and protection costs
  - Thermal energy impacts and adaptation costs
Agriculture

- New infrastructure to adapt
  - Machinery
  - Irrigation systems
- Pest and disease management
- R&D
  - Seeds
  - Techniques
- Change in location
## Coastal Resources
### Cost of Erosion Protection in Alaska

<table>
<thead>
<tr>
<th>Community</th>
<th>Costs of Future Erosion Protection</th>
<th>Cost to Relocate</th>
<th>How Long Does The Community Have*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bethel</td>
<td>$5,000,000</td>
<td>N/A</td>
<td>&gt; 100 years</td>
</tr>
<tr>
<td>Dillingham</td>
<td>10,000,000</td>
<td>N/A</td>
<td>&gt; 100 years</td>
</tr>
<tr>
<td>Kaktovik</td>
<td>40,000,000</td>
<td>$20 – 40 Million</td>
<td>&gt; 100 years</td>
</tr>
<tr>
<td>Kivalina</td>
<td>15,000,000</td>
<td>$95 – 125 Million</td>
<td>10 – 15 years</td>
</tr>
<tr>
<td>Newtok</td>
<td>90,000,000</td>
<td>$80 – 130 Million</td>
<td>10 – 15 years</td>
</tr>
<tr>
<td>Shishmaref</td>
<td>16,000,000</td>
<td>$100 – 200 Million</td>
<td>10 – 15 years</td>
</tr>
<tr>
<td>Unalakleet</td>
<td>30,000,000</td>
<td>N/A</td>
<td>&gt; 100 years</td>
</tr>
</tbody>
</table>

*These numbers assume no future erosion protection, including that listed here, is not implemented.

Some Sectors Have Received Little Attention

• Transportation
  – Costs for adapting to sea level rise
  – Costs for adapting changes in flooding
  – (NRC recently released major study)

• Energy Demand
  – Few studies estimating costs
3. Extreme Events Not Well Addressed

- It has been easier to model mean changes in climate and its impacts.
- Changes in extremes may be felt in near term.
- Costs could be significant.
# Building Drainage for Urban Flooding in La Ceiba Honduras: +30%

<table>
<thead>
<tr>
<th>COST</th>
<th>50 Year Design Storm (current climate)</th>
<th>50 Year +13% Design Storm</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIPE</td>
<td>$2,400,000</td>
<td>$3,200,000</td>
</tr>
<tr>
<td>Pumps</td>
<td>$900,000</td>
<td>$1,100,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$3,300,000</td>
<td>$4,300,000</td>
</tr>
</tbody>
</table>
4. What is Climate Change Adaptation?

- Most of the adaptations that are typically mentioned make sense anyway
  - e.g., better coastal management, improved water management, ecosystem protection
  - “No regrets”
- If no regrets, then climate change not needed to justify them
- If so, should the costs of implementing them be counted as climate change adaptation costs?
5. Few Studies on Benefits of Adaptation

• Little known about whether benefits justify costs
  – Also if services (welfare) is maintained

• Nkomo et al. 2006 examined Berg River Dam in South Africa
  – Dam is justified under climate change
  – Greater net benefits by instituting water markets
Conclusion

• There is a lot to learn on adaptation costs and benefits!

• We should be sure to study the most expensive adaptations

• Should also be sure to address climate change justified adaptations
Some Challenges

• Adaptation will occur in many sectors at many levels
  – Many adaptations will be difficult to monitor and record

• Can we get a handle on the costs?