Adaptation as an Innovation Challenge

Roger A. Pielke, Jr.
University of Colorado

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Outline

- An opening case study
- Adaptation as conventional wisdom
- Adaptation as innovation
- Various examples
- Concluding thoughts
Spot the difference

1999 Super cyclone “Paradip”
Peak winds = 160 mph
~10,000 deaths

2013 Super cyclone “Phailin”
Peak winds = 160 mph
~40 deaths
“[T]his was no miracle. This was an effort of epic proportions in making sure the horrors of 1999 would not be revisited. The Chief Minister of the State of Odisha had right at the onset declared that the entire state government was working to make sure there would be zero casualties. Close to a million people were evacuated. Evacuating a million people means, you need to know where you will be housing them or sending them to safer locations inland. These decisions are not taken ad-hoc.

The state over the past decade has been investing in building cyclone shelters and strengthening other coastal infrastructure. Additional 285 cyclone shelters are being built (150 in Odisha and 135 in Andhra Pradesh), more than 1000 kilometers of evacuation roads and 23 bridges to enhance connectivity and evacuations are being constructed, around 200 km of existing coastal/saline embankments are being strengthened and a new early warning system that will help disseminate warnings down to the “last-mile” community level is being set-up in Odisha and Andhra Pradesh. Cyclone shelters under the project are being constructed as multi-purpose buildings to be used as schools or community centers during regular time to ensure that the building is in working condition when needed in an emergency period.”

Saurabah Dani, World Bank 2013
What is “climate change”?
Two different definitions:

**IPCC** . . . change arising from any source.

**FCCC** . . . a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.
Framework Convention on Climate Change

GOAL

... to achieve ... stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.
Adaptation Under the Logic of the FCCC

Adaptation is required if stabilization occurs at a level higher than 450 ppm (or 2 degrees C).

Any stabilization level above 2 degrees C results in dangerous climate change.
There are no impacts until 2 degrees has been reached.
Reducing climate impacts: IPCC Perspective

Vulnerability

Climate change and variability
- Natural-Internal
- Natural-External
- Human-GHG
- Human-Non-GHG

Climate Impacts On Society and Environment
Reducing climate impacts: FCCC Perspective

Climate Impacts On Society and Environment

Climate change and variability

Human-GHG

Reducing climate impacts: FCCC Perspective

Climate Impacts On Society and Environment

Climate change and variability

Human-GHG
Conventional wisdom: If dangerous climate change can be avoided, then adaptation would be unnecessary

- Adaptation is thus a **cost** of climate change
- A need for adaptation represents failed mitigation
- IPCC cost-benefit analysis have classified adaptation as having costs but no benefits
- Adaptation is a “laziness” – Al Gore, *Earth in the Balance*
- Adaptation is “genocide” – Tim Flannery, author of *The Weather Makers*
What is “innovation”?

“Innovation is change that creates a new dimension of performance.”

Peter Drucker
Adaptation as innovation

Production Functions

Inputs
- Land
- Labor
- Capital
- Entrepreneurship

Outputs
- Cars
- Houses
- Food
- Computers
Schumpeter on Innovation – Five Types

- Product (weather radar)
- Process (evacuation system)
- Market (insurance)
- Resource (World Bank financing)
- Organization (disaster relief)

“. . . any “doing things differently” in the realm of economic life - all these are instances of what we shall refer to by the term Innovation. It should be noticed at once that the concept is not synonymous with “invention”. . . It is entirely immaterial whether an innovation implies scientific novelty or not.”

Schumpeter 1947
Decreasing deaths and death rates

Figure 1  Global death and death rates due to extreme events, 1900–2006

Deaths per year (in 1000s)
Death rates per year (per million)

Note that in figures 1 through 4, data for the last period are averaged over seven years worth of data.

Source: Goklany 2008
Data from CRED in Belgium

Number of people reported killed by natural disasters 1900 - 2011
End of era of mega-disasters?

Number of people reported killed by natural disasters 1900 - 2011

EM-DAT: The OFDA/CRED International Disaster Database - www.emdat.be - Université Catholique de Louvain, Brussels - Belgium
A big problem/opportunity remains

Number of people reported killed by natural disasters 1975 - 2011

EM-DAT: The OFDA/CRED International Disaster Database - www.emdat.be - Université Catholique
Increasing disaster losses $$\$$
Total Losses as % of global GDP

Global Weather-Related Disaster Losses as a Proportion of Global GDP: 1990-2012

Sources: Munich Re, World Bank
Insured losses as % of Global GDP

Exhibit 15: Global Insured Catastrophe Loss as a Percentage of GDP

Source: Aon Benfield 2013
US tornado deaths

US Tornado Deaths/Million People

Figure courtesy Harold Brooks, NOAA
“City [Tacloban] and national officials had days of warning and rushed to prepare. By week's end, the officials believed they had the situation in hand.

But many of their efforts, it turned out, were woefully inadequate. Some officials miscalculated the biggest threat that Typhoon Haiyan posed to the city and its surroundings. They used a term for the storm that wasn't widely understood. They grossly underestimated the havoc the storm would wreak, stocking far too few supplies for a city to survive on in an emergency. And they failed, despite vigorous efforts, to move many of the most vulnerable people out of harm's way.”

Wall Street Journal, Nov 26, 2013
### Effect of Thai floods on Japanese companies

<table>
<thead>
<tr>
<th>Status</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Automobiles</strong></td>
<td></td>
</tr>
<tr>
<td>Honda</td>
<td>Factory submerged</td>
</tr>
<tr>
<td>Toyota</td>
<td>Parts not supplied by flood-damaged manufacturer</td>
</tr>
<tr>
<td>Nissan</td>
<td>Production suspended</td>
</tr>
<tr>
<td>Isuzu</td>
<td>Until Saturday. Considering air shipment of parts and other measures</td>
</tr>
<tr>
<td></td>
<td>Until Wednesday</td>
</tr>
<tr>
<td></td>
<td>Until Friday</td>
</tr>
<tr>
<td><strong>Electronics</strong></td>
<td></td>
</tr>
<tr>
<td>Nikon</td>
<td>Digital camera factory submerged</td>
</tr>
<tr>
<td>Sony</td>
<td>No prospect of recovery</td>
</tr>
<tr>
<td>Canon</td>
<td>Printer-related factory submerged</td>
</tr>
<tr>
<td></td>
<td>Considering production at a different factory in Thailand and other areas</td>
</tr>
<tr>
<td>Nidec</td>
<td>Two electronic parts factories submerged and employees at four factories evacuated</td>
</tr>
<tr>
<td></td>
<td>Considering production in China and other countries</td>
</tr>
<tr>
<td>TDK</td>
<td>Electronic parts factory submerged</td>
</tr>
<tr>
<td></td>
<td>Considering production at a different factory in Thailand</td>
</tr>
<tr>
<td><strong>Food</strong></td>
<td></td>
</tr>
<tr>
<td>Ajinomoto/Calpis</td>
<td>Jointly established beverage plant submerged</td>
</tr>
</tbody>
</table>

### Thailand Flood Losses

**Reported by Insurers and Reinsures**

<table>
<thead>
<tr>
<th>Insurer/Reinsurer</th>
<th>Low Estimate</th>
<th>High Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>NKSJ Holdings</td>
<td>$1,300</td>
<td></td>
</tr>
<tr>
<td>Munich Re</td>
<td>$640 (£)</td>
<td></td>
</tr>
<tr>
<td>Swiss Re</td>
<td>$600</td>
<td></td>
</tr>
<tr>
<td>Zurich Financial</td>
<td>$250</td>
<td>$300</td>
</tr>
<tr>
<td>XL Group</td>
<td>$135</td>
<td>$185</td>
</tr>
<tr>
<td>SCOR</td>
<td>$180 (£)</td>
<td></td>
</tr>
<tr>
<td>Everest Re</td>
<td>$145</td>
<td></td>
</tr>
<tr>
<td>PartnerRe</td>
<td>$120</td>
<td></td>
</tr>
<tr>
<td>Endurance</td>
<td>$76.5</td>
<td></td>
</tr>
<tr>
<td>Transatlantic</td>
<td>$72</td>
<td></td>
</tr>
<tr>
<td>Arch</td>
<td>$35</td>
<td>$65</td>
</tr>
<tr>
<td>Validus</td>
<td>$54.1</td>
<td></td>
</tr>
<tr>
<td>Aspen</td>
<td>$54</td>
<td></td>
</tr>
<tr>
<td>Allied World</td>
<td>$40</td>
<td>$50</td>
</tr>
<tr>
<td>Axis Capital</td>
<td>$48</td>
<td></td>
</tr>
<tr>
<td>RenaissanceRe</td>
<td>$45</td>
<td></td>
</tr>
<tr>
<td>Argo Group</td>
<td>$25</td>
<td>$35</td>
</tr>
<tr>
<td>Sirius International Group</td>
<td>$34</td>
<td></td>
</tr>
<tr>
<td>Alterra</td>
<td>$30</td>
<td></td>
</tr>
<tr>
<td>Platinum Underwriters</td>
<td>$27.9</td>
<td></td>
</tr>
</tbody>
</table>

*Source: Moody's/Company announcements*

(1) Munich Re: £500 million
(2) SCOR: £140 million
Thames Barrier – a major non-flood
Global food production

**Global Food Production:**

kcal/person/day 1961-2007

Source: FAOSTAT

[http://rogerpielkejr.blogspot.com](http://rogerpielkejr.blogspot.com)

11 July 2012
Drought Impacts

Drought Cost as Percent of US GDP:
1980 = 100

Sources: USA Today, BEA
http://rogerpielkejr.blogspot.com
26 July 2012
A baseline for evaluating success

Total Losses per Year from Atlantic Tropical Cyclones in 2005 Dollars
Society changes in dramatic fashion

Miami Beach 1926

Miami Beach 2006

Wendler Collection

Joel Gratz © 2006
US normalized hurricane losses

Normalized US Hurricane Losses: 1900-2010

Billions 2009 US$

- 200
- 180
- 160
- 140
- 120
- 100
- 80
- 60
- 40
- 20
- 0
Data on hurricane landfalls can be used to evaluate a normalization of losses. With no upwards trends in hurricane landfall frequency or intensity, there is simply no reason to expect to see an upwards trend in normalized losses.
Why is it difficult to see a climate signal in a loss record?

Idealized Comparison of the Effects on Damages of Climate and Societal Changes Over 50 Years

- green: climate change (10% increase in intensity, raised to the 6th power)
- red: societal change (doubling of losses every 10 years)
Peer reviewed studies – normalized losses

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Region</th>
<th>Period</th>
<th>Normalization</th>
<th>Normalized loss</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bushfire</td>
<td>Australia</td>
<td>1900-2009</td>
<td>Wealth, population</td>
<td>No trend</td>
<td>Crompton et al. 2011</td>
</tr>
<tr>
<td>Flood</td>
<td>Europe</td>
<td>1970-2006</td>
<td>Wealth, population</td>
<td>No trend</td>
<td>Barredo 2009</td>
</tr>
<tr>
<td>Flood</td>
<td>USA</td>
<td>1926-2000</td>
<td>Wealth, population</td>
<td>No trend</td>
<td>Downton et al. 2005</td>
</tr>
<tr>
<td>Hurricane</td>
<td>Latin America</td>
<td>1944-1999</td>
<td>Wealth, population</td>
<td>No trend</td>
<td>Pielke et al. 2003</td>
</tr>
<tr>
<td>Hurricane</td>
<td>USA</td>
<td>1900-2005</td>
<td>Wealth, population</td>
<td>No trend</td>
<td>Pielke et al. 2008</td>
</tr>
<tr>
<td>Hurricane</td>
<td>USA</td>
<td>1950-2005</td>
<td>GDP, population</td>
<td>No trend</td>
<td>Schmidt et al. 2009</td>
</tr>
<tr>
<td>Tornado</td>
<td>USA</td>
<td>1890-1999</td>
<td>Wealth</td>
<td>No trend</td>
<td>Brooks and Doswell 2001</td>
</tr>
<tr>
<td>Typhoon</td>
<td>India</td>
<td>1977-1998</td>
<td>Income, population</td>
<td>No trend</td>
<td>Raghavan and Rajesh 2003</td>
</tr>
<tr>
<td>Weather</td>
<td>Australia</td>
<td>1967-2006</td>
<td>Wealth, population</td>
<td>No trend</td>
<td>Crompton and McAneney 2008</td>
</tr>
<tr>
<td>Weather</td>
<td>USA</td>
<td>1951-1997</td>
<td>Wealth, population</td>
<td>No trend</td>
<td>Choi and Fisher 2003</td>
</tr>
<tr>
<td>Weather</td>
<td>World</td>
<td>1950-2005</td>
<td>GDP, population</td>
<td>No trend</td>
<td>Miller et al. 2008</td>
</tr>
</tbody>
</table>

Source: adapted from Bouwer, (2011)
Concluding thoughts

- Adaptation as “innovation” is contrary to conventional wisdom of climate policy
- Innovations take many forms, adaptation to climate can be a central focus but often is a secondary consideration to other actions
- A richer, more interconnected world sees changes in vulnerabilities, adaptation focuses on a moving target (changes in climate are part of that, but may not be most significant)
- Less loss of life is accompanied by greater financial losses
- Technological innovations can be important, but innovations in political and social systems can be more important
- Ability to innovate comparable to “adaptive capacity”
- We should not underestimate how much we know, and how successful we have been with respect to outcomes
Outline

- An opening case study
- Adaptation as conventional wisdom
- Adaptation as innovation
- Various examples
- Concluding thoughts
Thank you!

- pielke@colorado.edu
- Papers etc. can be downloaded from: http://sciencepolicy.colorado.edu
- Weblog: http://rogerpielkejr.blogspot.com/