Reducing Coastal Risk

Committee on U.S. Army Corps of Engineers Water Resources Science, Engineering, and Planning: Coastal Risk Reduction

National Research Council
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Statement of Task

Focus on reducing flood risk from storms along the East and Gulf Coasts:

• To what extent have coastal risk-reduction strategies proven effective (life safety, economic return)?

• What are the regional and national implications of expanded coastal risk reduction?

• How might risk-related principles contribute to project design standards and increase community preparedness?

• What general principles might be used to guide future U.S. investments in coastal risk reduction?

Sponsored by USACE, as the 3rd phase of a 5-year study to provide advice on a range of scientific, engineering, and water resources planning issues
Study Process

• 14 month study
• 5 in-person meetings (DC; Mobile, AL; Newark, NJ)
• Briefings from federal and state agencies, Congressional staff, community managers, private sector, academia
• Peer-reviewed consensus report
Study Context

• 8 U.S. cities in global top 20 of estimated average annual losses from coastal storm flooding

• Hurricanes Sandy and Katrina highlighted the nation’s vulnerability

Image source: NASA
Study Context

• Tropical storms and floods comprise ~50% of all natural disaster losses in the U.S.

• Extensive and growing loss from natural disasters
  – increase of people and property in harm’s way
  – sea level rise is exacerbating problem
  – additional challenges due to climate change

• Increasing % of damages covered by federal aid

Data source: NOAA
Landscape for Coastal Risk Management

• **No central leadership or unified vision:** Responsibilities spread over multiple levels of government
  – FEMA, USACE, HUD, NOAA, USGS; state, local governments
  – Each driven by different objectives, authorities
  – No coordinating body with singular focus on coastal risk
  – No national priorities

• **Vast majority of funding for coastal risk-related issues is provided only after a disaster occurs**
  – Mostly for response & recovery
  – Small fraction for mitigation

*Image source: NOAA*
Landscape for Coastal Risk Management

• Few comprehensive regional evaluations of coastal risk have been performed
  – Risk reduction efforts tend to be local, not regional
  – USACE is not authorized to address coastal risk at a national scale.

• Lack of alignment of risk, reward, resources, and responsibility
  – Resulted in significant inefficiencies and inappropriate incentives that increase the nation’s exposure to risk

Image source: NOAA
Risk Reduction Strategies

RISK = HAZARD \times CONSEQUENCE

• Reduce the hazard (flooding, wave attack)
  – Hard structures (seawalls, surge barriers)
  – Nature-based strategies
    – Beach nourishment and dune building
    – Saltmarsh, seagrass, reefs

• Reduce the consequences
  – Building elevation and flood proofing
  – Non-structural (e.g., Land-use planning, preparedness, buyouts)

Optimal approaches will be site-specific, may involve multiple strategies

Image sources: N. Aquino, FEMA, committee
Strategies to Reduce the Hazard: Beach Nourishment and Dune Building

- Short term environmental impacts significant; long-term impacts unknown
- Can be designed to reduce short-term impacts and increase ecological value

[Image source: NOAA]

[Graph showing the number of beach nourishment and structure projects by decade, from 1950s to 2010s, with a peak in the 1980s and a decrease in the 2000s.]

Data source: USACE

Image source: NOAA
Strategies to Reduce the Hazard: Other Nature-Based Approaches

Saltmarsh, seagrass, mangroves, coral or oyster reefs, etc.

• **Provides substantial ecological benefits and varying levels of coastal risk reduction**
  – More effective on waves than surge
  – May require large expanses of habitat
  – Continued research needed to quantify effects

• May involve both conservation and restoration activities
Strategies to Reduce the Hazard: Hard Structures

- Hard structures are likely to become increasingly important in densely populated urban areas - space is limited for nature-based strategies.
- Adverse environmental impacts exist, designs can lessen these impacts.

Look for ways to couple hard structures and nature-based strategies.
Strategies to Reduce the Consequences

• Includes hazard zoning, building elevation, land purchase, and setbacks

• **High documented benefit-cost ratios (5:1 to 8:1)**

• Given less attention by the federal government

• Other than building elevation, these are viewed as difficult to implement by states

*Image source: FEMA*
Guiding Investments in Risk Reduction

Two basic approaches for evaluating investments:

1) Risk-standard
2) Benefit-cost

• There is no basis to justify a default 1-percent annual chance (100-year) design level for coastal risk.

• Benefit-cost analysis constrained by acceptable risk and social and environmental dimensions provides a reasonable framework
  – Constraints could include mass casualties or individual risk
  – Costs/benefits that are difficult to measure can also be constraints
Guiding Investments in Risk Reduction

• Capacity to consider life-safety, environmental, social costs and benefits is limited in USACE current decision framework.
  – National Economic Development (NED) given priority
  – Social and environmental benefits rarely influence decision making
  – Life-safety only recently a consideration for dams and levees.

• *Principles and Requirements for Federal Investments in Water Resources (CEQ, 2013)* provide an effective framework to account for these other costs and benefits.
  – Improvement upon current planning framework
Guiding Investments in Risk Reduction

• CEQ should expedite efforts to complete accompanying guidelines required to implement the *P&R*.

• Until then, **there are steps USACE could take** to improve consideration of multiple benefits and costs.
  
  – More quantitative assessment of other costs and benefits, besides NED

Image source: Mass.gov
Vision Toward Coastal Risk Reduction

• A National Vision for coastal risk management is needed.
  – Use federal resources to reduce coastal risk vs enabling it to increase
  – Clarify roles and responsibilities of federal, state and local governments for reducing coastal risk

• The federal government should work with states to develop a **national coastal risk assessment**
  – Use this to assess economic, life-safety, social, and environmental costs and benefits under various risk management scenarios

Image source: NOAA
Vision Toward Coastal Risk Reduction

• **Stronger incentives are needed** to improve pre-disaster risk mitigation efforts at the local level
  – Better align risk, rewards, responsibilities

• **The USACE should seize opportunities within its existing authorities** to strengthen coastal risk reduction
  – Evaluate incentives (e.g., cost-share) for sound planning
  – Develop modeling tools
  – Reevaluate 50-yr planning horizon

Summary

- **Coastal risk is increasing**
- Past investments have largely been *reactive rather than proactive*
- **Full array of risk reduction strategies** should be considered
- A *national vision* for coastal risk management is needed
- Federal government, states should develop a *national coastal risk assessment*
- **Benefit-cost analysis** (constrained by *acceptable risk*, social/environmental considerations) is an appropriate decision framework for investments
- **Stronger incentives** needed to better align risks, rewards, and responsibilities
More resources:

- Full report at www.nap.edu
- Additional resources under “Related Resources” tab:
  - 4 page report brief
  - Key issues slide show
  - Video
- Webinar and slides will be posted at dels.nas.edu