Climate Change Adaptation
Definitions, typologies, options, barriers
February 2015
Presentation Outline

• Definitions
• Typologies of adaptation
• Adaptation options
• Definition and typologies of barriers to adaptation
• A diagnostic framework for understanding and identifying barriers to the process of adaptation
Introduction to Climate Adaptation

Adaptation is first of all a process…

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Definitions (I)

• **Adaptation** is an adjustment in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts (IPCC, 2001).

• The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climate and its effects (Noble et al., 2014).

• **Adaptation is critical** if cities are to attain their desired developmental, environmental, human health, and economic outcomes under a changing climate.
Definitions (II)

- **Incremental adaptation**: Adaptation actions where the central aim is to *maintain the essence and integrity of a system or process* at a given scale.

Noble et al., 2014
#5 LOWER EAST SIDE: MANHATTAN WATER MACHINE

- Stormwater Cascade
- Cool Water Storage
- Split Sewage System
- Fully Protect

(Rebuild By Design, 2013)
Definitions (III)

- **Transformational adaptation**: Adaptation that *changes the fundamental attributes of a system* in response to climate and its effects. (Noble et al., 2014)

International Food Policy Research Institute (IFPRI), 2014
Definitions (IV)

• The distinction between incremental and transformational affects how we approach adaptation, how we integrate it into planning/policy, how we allocate adaptation funding (Noble et al., 2014).
Definitions (V)

- **Adaptation deficit**: Gap between the current state of a system and a state that would minimize adverse impacts from existing climate conditions and variability (Burton, 2009). (“development deficit” World Bank, 2010)
What to adapt to?
Climate Change is Affecting Human Health and the Environment

Infrastructure
- Water
- Transportation
- Energy Supply & Use

Health
- Weather-related Mortality
- Infectious Diseases
- Air Quality - Respiratory Illnesses

Agriculture
- Crop yields
- Irrigation demands

Forest
- Change in forest composition
- Shift geographic range of forests
- Forest Health and Productivity

Water Resources
- Changes in water supply
- Water quality
- Increased competition for water

Coastal Areas
- Erosion of beaches
- Inundate coastal lands
- Costs to defend coastal communities

Wildlife and Ecosystems
- Shift in ecological zone
- Loss of habitat and species
- Damage to Coral Reefs

Cultural Resources

Economic Disruption
Adaptation in Natural and Human Systems

We can plan ahead.... or we can react

Wildlife can only react

But humans can anticipate

(Main CN Line Near Amherst, NS)
Typologies of Adaptation

Nature mostly reacts. Humans can anticipate.

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Adaptation Human Systems

Investments in Adaptation

It’s not a question of *if* you’ll pay to adapt...

It’s a question of *when* you’ll pay.

We can plan ahead and get to where we want to go
(Anticipatory Adaptation)

We can incur damages later, clean up the mess, and live with the consequences
(Reactive Adaptation)

**GREEN ROOFS Programs in Urban Areas**

*Help address:*

- stormwater runoff
- urban heat island effect
- regional warming due to global climate change

*or...*

(Scheraga, 2010)
Reactive Adaptation

- **Reactive adaptation** involves a deliberate response to a climatic shock or impact, in order to recover and prevent similar impacts in the future.
Reactive Adaptation

• We cannot rely on reactive adaptation alone

  – Reactive adaptation may be “too little too late” in some cases (e.g. loss of a species)

  – Reactive adaptation may cost more than anticipatory adaptation

  – Reactive adaptation runs the risk of being short-sighted by focusing on the crisis at hand
Autonomous Adaptation

Autonomous adaptation refers to those actions that are taken as individual institutions, enterprises, and communities independently adjust to their perceptions about climate risk. Such autonomous actions may be short-term adjustments, and are often considered as a reactive or bottom-up approach.
Anticipatory Adaptation

- Anticipatory or proactive adaptation involves planned action, in advance of climate change, to prepare for and minimize its potential impacts:
  - taking steps to reduce the risks associated with climate change for individuals, communities and ecosystems
  - the result of deliberate policy decision, based on the awareness that conditions have changed or are expected to change, and that some form of action is required to maintain a desired state (PLANNED ADAPTATION)
Anticipatory Adaptation

- Anticipatory planning is often more effective and less costly than reactive planning, and can provide benefits today:
  - Reduce heat island effect by introducing public transport, green belts, urban trees, parks, and roof gardens
  - Improved drought planning, conservation efforts, water re-use, new building designs
## Summary: Types of Adaptation

<table>
<thead>
<tr>
<th></th>
<th>Anticipatory</th>
<th>Reactive</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Natural systems</strong></td>
<td></td>
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<tr>
<td>Private</td>
<td>Purchase of insurance</td>
<td>Changes in length of growing</td>
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<td></td>
<td>Construction of house on stilts</td>
<td>Changes in ecosystem composition</td>
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<td></td>
<td>Redesign of oil-rigs</td>
<td>Wetland migration</td>
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<td>Public</td>
<td>Early-warning system</td>
<td>Changes in farm practices</td>
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<td></td>
<td>New buildings codes, design standards</td>
<td>Changes in farm insurance premiums</td>
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<td></td>
<td>Incentives for relocation</td>
<td>Purchase of air-conditioning</td>
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</table>
Why is adaptation necessary?

• Climate change is already occurring

• Significant climate change impacts are projected, and the impacts expected within the next few decades are largely unavoidable

• Decisions with long-term impacts are being made every day. Today’s choices will shape tomorrow’s vulnerabilities

• Proactive, long-term changes are cheaper than reactive, short-term ones

• Immediate benefits can be gained with regard to climate variability

• Immediate benefits can be gained with regard to bad practices
Adaptation Options

From soft to hard options and the North-South divide

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Types of Adaptation Options

- “Grey” infrastructure options
- “Green” infrastructure options
- “Soft” options
<table>
<thead>
<tr>
<th>Grey measures</th>
<th>Green measures</th>
<th>Soft measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Make new buildings and infrastructure flood proof by appropriate design and</td>
<td>• Avoid/remove impervious surfaces wherever possible.</td>
<td>• Mapping of flood risks taking into account climate change scenarios and</td>
</tr>
<tr>
<td>material use.</td>
<td>• Maintain and further increase green infrastructure in cities, parks and</td>
<td>information distribution.</td>
</tr>
<tr>
<td>• Maintenance/upgrade of drainage system.</td>
<td>gardens, wetlands, water bodies but also green roofs.</td>
<td>• Forecasting and early warning systems.</td>
</tr>
<tr>
<td>• Temporary water storage in basins or fascines.</td>
<td>• Maintain and manage green areas outside and inside the cities for flood</td>
<td>• Awareness raising, knowledge and capacity building for all groups to cope</td>
</tr>
<tr>
<td>• Separate treatment of rain water, disconnected from sewage, improved</td>
<td>retention including the use of appropriate agricultural and forest practices.</td>
<td>with floods and flood risks.</td>
</tr>
<tr>
<td>ground drainage.</td>
<td>• 'Re-naturalisation' of rivers and wetlands.</td>
<td>• Strategic planning in river basins — ban building in flood prone areas,</td>
</tr>
<tr>
<td>• Innovative design of buildings and areas such as elevated entrances,</td>
<td></td>
<td>protect flood retention and other green areas.</td>
</tr>
<tr>
<td>building on poles, floating houses, temporary water storage, green roofs.</td>
<td></td>
<td>• Flood risk management plans.</td>
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<tr>
<td>• Dams, flood defences.</td>
<td></td>
<td>• Rain water management.</td>
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<td></td>
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<td>• Guidance for behaviour changes such as not storing valuables in basements.</td>
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<td></td>
<td></td>
<td>• Adapting building and planning codes to include flood resistance.</td>
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<td>• Taxes or incentives, such as concerning the amount of sealed area per</td>
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<td>property, amount of waste water used (including rain water).</td>
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<td></td>
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<td>• Insurance of damages.</td>
</tr>
</tbody>
</table>
### Table 2.3 Overview on grey, green and soft adaptation measures to heatwaves following the structure of Box 2.2

<table>
<thead>
<tr>
<th>Grey measures</th>
<th>Green measures</th>
<th>Soft measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Building insulation to keep the inside cool</td>
<td>- Boosting green infrastructure, such as green urban areas, trees, green walls and roofs where possible, but ensuring sustainable watering</td>
<td>- General awareness raising and ensuring broad participation</td>
</tr>
<tr>
<td>- Blinds to provide shade</td>
<td>- Ensuring that fresh air from green areas outside the city can flow in</td>
<td>- Mapping of urban heat island as well as cool places</td>
</tr>
<tr>
<td>- Passive cooling of buildings</td>
<td></td>
<td>- Identification of vulnerable groups and their distribution as basis for targeted action</td>
</tr>
<tr>
<td>- Urban designs providing shade</td>
<td></td>
<td>- Warning systems</td>
</tr>
<tr>
<td>- Ventilation of urban space by intelligent urban design</td>
<td></td>
<td>- Heat action plans including appropriate institutional structures</td>
</tr>
<tr>
<td>- Emission reduction of air pollutants</td>
<td></td>
<td>- Preparedness of health and social care system</td>
</tr>
</tbody>
</table>

Source: EEA, 2012
The “North-South” divide

(Bosello, 2007 in Satterthwaite, 2007)
Global North

**Context**
- High per capita emissions
- Access to technology and experts
- Enforcement of environmental legal framework
- Resilient infrastructures
- Political agenda
- Raising political instability
- Economic stagnation

**Approach**
- Energy Departments with team of highly qualified mechanical, electrical, environmental engineers for implementation or RE projects (street lighting, buildings, municipal fleets)
- **Mitigation manifests in changes in lifestyle**
- **Adaptation manifests as changes in city designs**

Courtesy of ICLEI, 2013
## Global South

### Context
- Low per capita emissions
- Weak legal framework
- Non resilient infrastructures
- Political Instability
- Corruption

### Approach
- Low capacity
- Reliance on international cooperation (development agencies, multilateral development banks and external experts)
- Focusing on adaptation (except for waste management)
- Adaptation manifests through survival strategies or transformational changes
- Mitigation manifests as shifting from unsustainable use of resources and enhancing quality of life

Courtesy of ICLEI, 2013
Planning for Uncertainty

- “No regrets” strategies
  Provides benefits now with or without climate change

- “Low regrets” strategies
  Provide climate change benefits for little additional cost or risk

- “Win-win” or “Co-benefit” strategies
  Reduce climate change impacts while providing other environmental, social, or economic benefits
Adaptation Limits and Barriers

“Social and individual factors limit adaptation action” (Adger et al., 2009:339)

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Are there limits to Adaptation?

Renn and Klinke, 2013 in Klein et al., 2014
Are there limits to Adaptation?

- Adaptation Limit: The point at which an actor’s objectives or system’s needs cannot be secured from intolerable risks through adaptive actions.

- Adaptation Constraint or Barrier: A factor or process that makes adaptation planning and implementation more difficult

Source: Klein et al., 2014; Islam et al., 2014
Typologies of barriers to local (community) adaptation

- **Natural** (e.g. exceeding ecosystem thresholds, alterations)
- **Technological** (e.g. engineering structures, inaccurate information)
- **Economic** (cost of insurance, repairs, high upfront costs of adaptation)
- **Social** (ethics, knowledge, risk, culture)
- **Formal Institutional** (processes and rules that govern and regulate access to livelihood opportunities)

Islam et al, 2014
Barriers to the Process of Adaptation

“We must build adaptive capacity” … but for which aspects of the adaptation process, when, by which groups?

(Ekstrom, 2010)

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Barriers within government institutions

- Cultural/Behavioural: authenticity of commitments, silos, risk aversion
- Structural/Operational: budgetary inefficiencies and party rivalries
- Regulatory/Legislative: quality of policy and regulatory tools and interactions between levels

Burch, 2010
Elements of a diagnostic framework

- Rational approach to decision making
- Interconnected structural elements (Actors, Governance Context, System of concern) to study nature of and why barriers arise
- Cross-cutting issues
- Mapping the origin of barriers to locate the scale of influence

Moser, Ekstrom, 2010
Phases and Processes of Adaptation

IDENTIFICATION OF BARRIERS AT EACH STAGE

Moser, Ekstrom, 2010
Structural Elements of Adaptation

THE SYSTEM THAT NEEDS TO BE BETTER MANAGED

THE SPECIFIC GOVERNANCE SYSTEM AND LARGER ENVIRONMENT

WIDE-RANGING AND DYNAMIC OVER TIME

COMPLEX AND INTERCONNECTED SETS OF CHANGES

Moser, Ekstrom, 2010
### Barriers in the Understanding Phase

<table>
<thead>
<tr>
<th>Phase and process stages: Understanding</th>
<th>Barriers</th>
</tr>
</thead>
</table>
| Detect problem                         | Existence of a signal  
Detection (and perception) of a signal  
Threshold of concern (initial framing as problem)  
Threshold of response need and feasibility (Initial framing of response) |
| Gather/use of information              | Interest and focus (and consensus, if needed)  
Availability  
Accessibility  
Salience/relevance  
Credibility and trust  
Legitimacy  
Receptivity to information  
Willingness and ability to use |
| (Re)define problem                     | Threshold of concern (reframing of the problem)  
Threshold of response need  
Threshold of response feasibility  
Level of agreement or consensus, if needed |

Moser, Ekstrom, 2010
Phases and Processes of Adaptation

IDENTIFICATION OF BARRIERS AT EACH STAGE

Moser, Ekstrom, 2010
### Barriers in the Planning Phase

<table>
<thead>
<tr>
<th>Phase and process stages: Planning</th>
<th>Barriers</th>
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<tbody>
<tr>
<td>Develop options</td>
<td>Leadership (authority and skill) in leading process</td>
</tr>
<tr>
<td></td>
<td>Ability to identify and agree on goals</td>
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<tr>
<td></td>
<td>Ability to identify and agree on a range of criteria</td>
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<tr>
<td></td>
<td>Ability to develop and agree on a range of options</td>
</tr>
<tr>
<td></td>
<td>that meet identified goals and criteria</td>
</tr>
<tr>
<td></td>
<td>Control over process</td>
</tr>
<tr>
<td></td>
<td>Control over options</td>
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<tr>
<td>Assess options</td>
<td>Availability of data/information to assess options</td>
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<tr>
<td></td>
<td>Accessibility/usability of data</td>
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<tr>
<td></td>
<td>Availability of methods to assess and compare options</td>
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<tr>
<td></td>
<td>Perceived credibility, salience, and legitimacy of</td>
</tr>
<tr>
<td></td>
<td>information and methods for option assessment</td>
</tr>
<tr>
<td></td>
<td>Agreement on assessment approach, if needed</td>
</tr>
<tr>
<td></td>
<td>Level of agreement on goals, criteria, and options</td>
</tr>
<tr>
<td>Select option(s)</td>
<td>Agreement on selecting option(s), if needed</td>
</tr>
<tr>
<td></td>
<td>Sphere of responsibility/influence/control over option</td>
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<tr>
<td></td>
<td>Threshold of concern over potential negative</td>
</tr>
<tr>
<td></td>
<td>consequences</td>
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<td></td>
<td>Threshold of perceived option feasibility</td>
</tr>
<tr>
<td></td>
<td>Clarity of authority and responsibility over selected option</td>
</tr>
</tbody>
</table>

Moser, Ekstrom, 2010
Phases and Processes of Adaptation

- Detect problem
- Gather/Use info
- (Re)Define problem
- Develop options
- Select option(s)
- Assess options
- Implement option
- Monitor option and environment
- Evaluate
- Understanding
- Managing
- Planning

IDENTIFICATION OF BARRIERS AT EACH STAGE

Moser, Ekstrom, 2010
## Barriers in the Managing Phase

<table>
<thead>
<tr>
<th>Phase and process stages: Managing</th>
<th>Barriers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implement option(s)</td>
<td>Threshold of intent</td>
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<td></td>
<td>Authorization</td>
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<td></td>
<td>Sufficient resources (fiscal, technical, etc.)</td>
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<td></td>
<td>Accountability</td>
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<td></td>
<td>Clarity/specificity of option</td>
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<td></td>
<td>Legality and procedural feasibility</td>
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<td></td>
<td>Sufficient momentum to overcome institutional stickiness, path dependency, and behavioral obstacles</td>
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<tr>
<td>Monitor outcomes &amp; environment</td>
<td>Existence of a monitoring plan</td>
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<td></td>
<td>Agreement, if needed, and clarity on monitoring targets and goals</td>
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<td></td>
<td>Availability and acceptability of established methods and variables</td>
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<td></td>
<td>Availability of technology</td>
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<td>Availability and sustainability of economic resources</td>
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<td></td>
<td>Availability and sustainability of human capital</td>
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<td></td>
<td>Ability to store, organize, analyze, and retrieve data</td>
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<tr>
<td>Evaluate effectiveness of option</td>
<td>Threshold of need and feasibility of evaluation</td>
</tr>
<tr>
<td></td>
<td>Availability of needed expertise, data, and evaluation methodology</td>
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<td></td>
<td>Willingness to learn</td>
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<td></td>
<td>Willingness to revisit previous decisions</td>
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<td></td>
<td>Legal limitations on reopening prior decisions</td>
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<tr>
<td></td>
<td>Social or political feasibility of revisiting previous decisions</td>
</tr>
</tbody>
</table>

Moser, Ekstrom, 2010
Cross-cutting Barriers

- **Leadership**: initiating and sustaining momentum; formal and informal leadership; qualities of leadership
- **Resources**: financial, technical, information, time
- **Information and Communication**: whether, which, by whom and how is information created and how it is received
- **Values and Beliefs**: pre-existing values, beliefs, preferences, norms, colour general beliefs about society and the environment

Moser, Ekstrom, 2010
“Overcoming barriers depends on actors’ capabilities but also on the source and origins of the barrier”

Moser, Ekstrom, 2010:22030
Origin Matrix: The Location of Influence

PATH-DEPENDENCY

LOCATION OF THE ACTORS

Moser, Ekstrom, 2010
Summary

BARRIERS TO ADAPTATION

NATURE OF BARRIERS

WHY THEY ARISE

ORIGIN OF BARRIERS
Conclusions

• A roadmap to circumvent, remove or lower the barrier
• Not a fixed prescription of how to overcome barriers but a systematic diagnostic framework
• “We must build adaptive capacity” … but for which aspects of the adaptation process, when, by which groups?

Moser, Ekstrom, 2010
“understanding the interdependencies of barriers is central for explaining their occurrence, persistence and resolution.” (Eisenack et al, 2014:869)
Questions for Discussion

What is the difference between reactive and anticipatory adaptation? Why is anticipatory adaptation not enough?

Is your city planning or implementing any adaptation option? Can you describe them and categorise them between soft, green and grey?

What is the difference between a barrier and adaptation limits?

Can you make one example of a legacy/remote barrier? Why are they difficult to overcome?

Why are contemporary/proximate barriers easier to overcome instead? Can you explain with an example?
References

• Adger, W. N. et al. (2009), Are there social limits to adaptation to climate change? Climatic Change (93), 3-4, pp. 335–354.


References

