Urbanisation, Natural Hazards, Adaptation & Green Growth: Micro-Scale

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National Hazards, Adaptation, Green Growth

- Natural hazards have high impacts and economic costs today (adaptation deficit)
  - Direct (tangible & intangible), indirect & macro-economic effects
- Climate change expected to increase many of these extremes (IPCC SREX, 2012)
- Collaboration (formerly competition) is between DRM, adaptation & development
- But what about the green growth linkages?
- They do exist but potential for conflicts as well as synergies, and important barriers
Urban areas are vulnerable to current & future risks

- Recognition of natural hazards and climate change impacts at the city scale

Key risks for natural hazards and climate (adaptation)

- Focus: coastal floods/slr, river/urban flooding, heat extremes, wind storm

<table>
<thead>
<tr>
<th>Projection e.g. mean temperature or SLR</th>
<th>Market</th>
<th>Non-Market</th>
<th>Socially contingent</th>
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</thead>
<tbody>
<tr>
<td>SLR and storm</td>
<td>- Singapore (V)</td>
<td>- Singapore (V)</td>
<td>- Nile delta (qualit.)</td>
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<tr>
<td>Energy</td>
<td>- Athens (Q)</td>
<td>- Lisbon (Q)</td>
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<tr>
<td>- Boston (Q)</td>
<td>- Melbourne, Sydney, Brisbane (Q, V)</td>
<td>- Boston (Q)</td>
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<tr>
<td>- California (Q)</td>
<td>- Toronto (Q)</td>
<td>- Los Angeles (Q)</td>
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<tr>
<td>SLR</td>
<td>- New York (V)</td>
<td>- Los Angeles (semi-Q)</td>
<td></td>
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<tr>
<td>- London (Q)</td>
<td>- London (semi-Q)</td>
<td>- Chicago, Cincinnati (Q)</td>
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<tr>
<td>Riverine flooding</td>
<td>- Boston (V)</td>
<td>- Melbourne Sydney, Brisbane (Q)</td>
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<tr>
<td>Transport / infrastructure</td>
<td>- Boston (Q)</td>
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<tr>
<td>- Wellington</td>
<td>- Melbourne Sydney, Brisbane</td>
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<tr>
<td>Major change e.g. major tipping points</td>
<td>Major SLR</td>
<td>None</td>
<td>None</td>
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<tr>
<td>- London 4 to 5 m SLR</td>
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Natural hazards, DRM and Adaptation Convergence

Source IPCC SREX, 2012: IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation
National to Local Level linkages - Methods

- Methods for DRR-Adaptation
- Iterative risk / adaptive management approaches
- E.g. GGGI CRS Ethiopia
- Early focus on low and no-regret, mainstream, capacity building, iterative planning
- Synergies with mitigation through Multi-attribute analysis
- But green growth, DRR, adaptation and urban?

Figure source: Watkiss, P., Hunt, A., and Savage, M. Early no regret adaptation. Discussion note for DFID.
Global Scale: NH-Adaptation-GG linkages

- Urban areas are one of main sources of greenhouse gas emissions (GHG)
- Green growth reduces GHGs
- Thus GG reduces natural hazard risks by reducing long-term climate change
- However, the benefits of mitigation do not appear until after 2040
- Mitigation not reduce short-term hazards or early climate change

But what about links to green growth in urban areas?

- Primary policy domain is national to local. Cities drive emissions and growth

- NH/CC not primary driver: socio-economic change
  - Future population will be urban (60% by 2030, w/ 37 megacities*)
  - And our research and policy is compartmentalised (methods, timing, governance)**

- Natural hazard, climate change and adaptation
- Mitigation, green industrial policy
- Noting power imbalance in developing countries between MoE and MoF/PC
- So where is urban-DRM-adaptation-Green Growth nexus and what are the issues?

* UN population urbanisation statistics
Heat extremes

- Heat extremes have large impacts today, e.g. London
- Increased by urban heat island in large cities
- Heat related mortality and morbidity
- Lower productivity: outdoors ** and for cities indoors
- e.g. UK 30% @ 32°C = £125M/day*
- Or else increased energy for cooling**

CEBR (2003).
Heat extremes are likely to increase

Climate models project more frequent hot days throughout the 21st century

In many regions, the time between “20-year” (unusually) warm days will decrease

Source: IPCC SREX, 2012: IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation
Heat extremes and climate change

• Complex interactions between growth, climate change, autonomous adaptation, planned adaptation & mitigation

• Climate change lead to 30000 to 90000 additional urban deaths/yr by 2050s in EU with economic costs up to € 90 bill. year [VSL]*

• Short-term planned adaptation is heat alert (low cost) but not sufficient in long-term

• Climate change will also reduce urban productivity and decrease comfort levels

• But quantification challenging because of building and spatial specificity

• Likely to lead to autonomous response of air conditioning

Air Conditioning

- AC reduces mortality (by ~50% **)
- AC reduces productivity loss
- AC increases with climate change (autonomously)
- And AC penetration increases with income***
- Behavioural responses (events triggers uptake, cars)
- BUT AC has a cost, e.g. additional cost of climate change on cooling in EU = €110 bill/year by 2100 (Cap+Op)**
- B/C AC increases GHG unless decarbonised electricity

Iterative methods for planned synergistic alternatives

- Can start to assess some of these issues with iterative adaptive management

Planned adaptation responses involve challenges

• Some options are synergistic with mitigation, e.g. building design, passive vent. BUT
  • Only cost-effective during design (not retrofit), builder (cost) vs owner (benefit)
  • Designing for uncertain future climate is difficult*
  • Green space, positive but localised and land costs
  • Some options are in conflict with mitigation**
    • Low density cities reduce heat island effects and reduce cooling demand
    • But increase greenhouse gas emissions

Implementing synergistic policy is difficult

- Decisions taken by different actors, with different objectives/temporal perspective
- Social Network Analysis reveals we should not underestimate this challenge

Similar challenges for developing countries

- Rwanda: Green Growth and Climate Resilience National Strategy for Climate Change and Low Carbon Development

- Recommends low carbon urban systems - High density walkable cities

- Reduce fossil fuel use through transport and city design

- Reduced urban sprawl limits development of housing on steep slopes which are vulnerable to flooding and landslides

- But this will increase building density and increase heat island effects (i.e. conflict)

- Leads to general issue of heat extremes for developing cities – link to health, productivity and cooling for comfort
Convergence, e.g. India

- Income growth plus CC leads to huge increase in demand for cooling
- 25500 TWh for space cooling by 2100 (total A1B inc CC)
- Also increases peak demand and thus capacity
- Baseline least-cost generation is often coal or fossil
- And in rapidly developing countries, synergistic policy is very challenging, e.g. building codes, spatial planning
- Key issue for major developing cities in warm climates, e.g. Asia, Africa…….

Figures Akpinar-Ferrand Ezgi and Singh Ashbindu 2010 (Top)
Source: ClimateCost Project. Deliverable 3C Energy. Mima et al. 2011. (Centre and bottom)
Research gaps and issues

- Critical problem and research gap
  - Projections of future electricity demand based on today’s climate, not future w/ CC
    - LDC least cost power plans underestimate income effects and exclude CC
      - (noting we do this as well in the UK and Europe…..)
    - So we are underestimating the green growth challenge
  - Following from this, what is the best, realistic option?
    - Carbon tax (but what about effects on health and productivity?), efficient AC, decarbonisation, spatial planning, everything?
Flood events

- Key current natural hazard is flooding (river, flash-floods, coastal surge)
- Climate change will potentially exacerbate risks, but high uncertainty

DRM-Adaptation

- Focus on DRM-Adaptation and use of iterative risk management

- A set of no and low-regret options emerging, e.g.
  - Early warning systems, community based responses and management forums
  - Risk screening and planning growth towards less vulnerable areas
  - Planning, building design, etc.

- But most do not have a strong focus on mitigation/green growth

- So where are the synergistic GG-NH-urban-adaptation policies?
It is not around future infrastructure protection

- Lack of learning from the DRM literature in adaptation economics
- Too often river flooding response is for technical engineered infrastructure
- Similar focus on coastal dikes as the solution for climate change (B:C > 10:1)
  - Based on assumption of perfect foresight (if-then)
  - Assume existing good baseline protection (no adaptation deficit)
  - Ignore DRM literature (what works, maintenance, over-topping risks)
- Over-optimistic on costs (e.g. Dar 1.3km =$3.4 mill., next London barrier $9 bill)
- And pouring concrete increases embedded emissions
Green growth linkages around natural capital

- Management of natural capital (ecosystem services)
  - Upstream watershed management (afforestation) to reduce downstream floods
  - Coastal buffer zones (mangrove) and shoreline and sea-scape vegetation
- Integrated land/water resource management
- Integrated coastal zone management
However challenges for Synergistic policy

- Institutional capacity, enforcement, governance with IWRM/ICZM
- Opportunity costs of coastal buffer zones *
- Challenges in payment for ecosystem services approaches
- Sustainable management of forests or mangroves (CBF, REDD+**)
- Ensuring natural capital is climate resilience (e.g. future forests**)
- Designing buildings for multiple uncertain risks at low cost**
- Enforcement of planning regulations or building codes**


**Watkiss (2013). Supporting analysis for the Zanzibar Climate Change Strategy
Conclusions

- The current focus is on DRM-adaptation linkages

- Methods have emerged for addressing these together

- But so far, linkage to green growth not extensively explored

- While focus on floods, for urban areas, we should consider heat extremes as well
  - May be important conflict between mitigation and adaptation
  - Green growth policy needs to be planned with future climate in mind (CDD)

- Synergistic policy with green growth is possible, but requires planned intervention, and important cost, governance, enforcement barriers

- Critical research priority is needed to assess risks and responses