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Lessons from adaptation in practice
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Urban adaptation planning: the use and limits of climate science

Cities face a mounting challenge from climate change. In developed and developing countries alike, rising temperatures, changing rainfall patterns, higher sea levels, and more frequent and severe extreme events such as droughts and floods threaten to overwhelm urban infrastructure, services and management systems. City officials recognise the need to adapt to climate change, and use scientific evidence to support their plans for doing so. But the precise details of these changes and the local impacts they will have cannot be predicted. Decision makers must learn to draw on scientific data while simultaneously managing the uncertainty inherent in future projections. Across the world, forward-looking city officials are proving themselves to be 'urban adaptation leaders' — mobilising political and public support for and devising flexible approaches to adaptation.

Policy pointers

- **Cities must respond to** climate change: urban populations are growing, and residential, commercial, political and industrial areas are increasingly exposed to climate-related hazards.
- **Scientific evidence is** needed to support planning for climate change — to guide decisions and activities, and to mobilise political and public support for adaptation.
- **Many decisions will have** to be taken with uncertain evidence, and flexible approaches to adaptation in cities — involving both structural and non-structural measures — will help to improve the response.

The need to adapt

City officials, planners and residents around the world face a growing range of serious challenges. More than half of humanity now live in urban areas, and many cities are growing rapidly, especially in low- and middle-income countries. The world's urban population is expected to rise from 3.3 billion to some 5 billion over the next 20 years, placing further pressures on already stretched infrastructure and services including road networks, water and sanitation provision, and electricity generation.

At the same time, many towns and cities around the world are increasingly exposed to the impacts of climate change, including rising temperatures, changing rainfall patterns, higher sea levels, and more frequent and severe extreme events such as droughts and floods. Such impacts have the potential to overwhelm infrastructure, threaten urban plant and animal life, alter the habitability of many buildings, and stress existing infrastructure, emergency services, social services and urban management systems. For example, unplanned and informal settlements in cities such as Mombasa, Kenya are often found in hazardous locations, with a large number of low-income residents exposed to flooding and sea-level rise. In wealthier cities, expensive infrastructure may be at risk: in Toronto, Canada, the road infrastructure alone has a replacement value of nearly US$12 billion, while a project to reduce the frequency of basement flooding will cost the city authority US$825 million over ten years.

Considerable action is required at the local scale to adapt to the changes ahead and to protect urban residents, industries, societies and economies from the damage that climate change impacts can cause. Municipal authorities have the responsibility for a range of actions that can reduce risk. These include shaping the built environment through building codes, land use regulations and urban planning; and

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providing better-adapted infrastructure and services such as drainage, piped water, sanitation, public health provision and disaster response measures.

An uncertain future

Politicians, city officials and urban residents widely hold the view that urban climate change adaptation planning and action should be based on assessments rooted in scientific evidence. But there is also increasing recognition that climate science cannot provide certainty about future conditions, and that finding the best way to plan for climate impacts and identify appropriate responses is still a developing area of knowledge.

Planners and politicians cannot afford to wait for perfect evidence

And yet the threats arising from climate change cannot be ignored. Simply postponing action until there is greater certainty about future projections will increase the risks facing urban centres, their populations, industries, and those who depend on them.

Adaptation planning in urban areas therefore requires the use of scientific evidence about climate change, while simultaneously managing the uncertainty inherent in future projections.

Forward-looking city officials who are engaged with the challenges of climate change are already showing how this can be achieved in practice (see Learning from urban leaders).

Using evidence

Cities around the world are using different types of scientific evidence as a basis for understanding their vulnerability and planning for adaptation, and many officials see this information as a vital first step for setting priorities.

National assessments of future changes in climate do not provide the required level of detail for making specific plans, but regional assessments — such as the Regional Integrated Scientific Assessment (RISA) programme in the United States — may be more directly applicable.

Other cities have worked directly with scientists, sometimes based at local universities, to generate specific and detailed information. For example, the Municipal Authority in Durban, South Africa, worked with a consultant to develop models of local impacts resulting from sea level rise and changing temperature and rainfall.

Scientific evidence can be used directly in adaptation planning to guide the development of responses to particular impacts. Projected changes in temperatures, rainfall intensity or sea levels can help ensure that the necessary infrastructure and response strategies are in place. For example, predictions of dangerously high summer temperatures in Toronto, Canada have encouraged the expansion of cooling centres and the development of programmes targeting building retrofits that conserve heat in the winter and disperse heat in the summer.

Equally importantly, scientific evidence can help mobilise broader political support for adaptation. Risk maps derived from scientific data helped politicians in Copenhagen, Denmark, visualise where the threats were, and motivated them to support an adaptation programme. As one urban adaptation leader commented, scientific evidence “means there is the potential to lean on people and lean on institutions to achieve goals”.

Managing uncertainty

But there is still a great deal of uncertainty surrounding the specific details of future climate projections. Future emissions of greenhouse gases can only be estimated based on a range of socioeconomic development scenarios. And the way in which future atmospheric concentrations will interact with the climate system is also uncertain, particularly at the small spatial scale of cities.

Learning from urban leaders

The ideas presented in this briefing paper were developed during a series of discussions with officials from 14 cities (in Canada, Denmark, Ecuador, India, Indonesia, Japan, Jordan, Mozambique, Namibia, South Africa, South Korea, Taiwan, the United Kingdom and the United States) who are actively involved in adaptation planning. They were identified as ‘urban adaptation leaders’ because although they work in widely different contexts, with varying levels of economic and political support, they have a strong shared commitment to building resilience that has been recognised internationally by their peers.

As reflected in this briefing paper, the discussions highlighted that challenges and opportunities may differ, but that ‘urban adaptation leaders’ have developed innovative strategies and tactics to address these.

Unplanned and informal settlements, like Tudor Settlement in Mombasa, Kenya, are often found in hazardous locations where they are exposed to flooding and sea level rise.

Despite this, planners and politicians cannot afford to wait for perfect evidence. Climate impacts of some kind will increasingly be felt, and there are mounting social and political pressures to respond. This is well recognised by city officials working on adaptation, one of whom stated that scientific evidence "simply doesn't provide the silver bullet I think we hoped it would in terms of ultimate answers".

Several strategies are being developed to manage this uncertainty. One approach is to foster positive relationships with the academic community, ensuring that there is an ongoing discussion and continually updated information between the realms of science and policy.

This may or may not result in the production of new vulnerability assessments, but it should help to ensure that projections and analyses are routinely updated. Another approach adopted by city officials has been to work closely with technical staff, including engineers, to ensure flexibility in systems and responses. In addition, adaptation leaders identified the importance of approaches that cross sectors and disciplines. A practical example of this is combining larger drainage pipes with changes in individual and household behaviour that reduce the flow of water into these systems.

The efficacy of particular adaptation responses is also uncertain, and many adaptation officials promote the idea of adaptation as an ongoing repetitive process. One said "we have to learn by doing and while doing, because we have to act now... and I think that gives people a lot of opportunities to innovate and to create". These innovative mechanisms can be technical, organisational or political in nature. The city of Quito, Ecuador, has created an inter-institutional committee for responding to climate change that brings together a range of city officials, academic partners and citizens to identify the most appropriate responses.

Moving forward

There is an urgent need for cities to plan for adaptation, due to the concentration of people and wealth in rapidly growing urban areas, and the increasing risks faced due to climate change. Cities at the forefront of climate change adaptation have shown ways that scientific evidence can be used to support this process, but have also developed innovative means for dealing with uncertainty.

More effective adaptation planning in cities will require greater awareness of the value of what evidence exists, and of ways of responding when this is not as complete or as thorough as needed. And it will require the involvement of a range of stakeholders including citizen groups, the private sector, city and national governments, and financing institutions.

City authorities can learn from partnerships with academic and scientific institutions, who in turn should make sure their research is more targeted at the needs of adaptation planners. But this needs to be balanced by an awareness of flexible measures and integrated combinations of options that can be effective given the high levels of uncertainty within which decisions are taken.

Many low-income areas of cities are located on marginal land, such as these steep slopes outside Santo Domingo, Dominican Republic. Urban residents here have worked with NGOs and the local authority to improve evacuation routes for use during extreme weather events and flooding.

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This paper draws on the findings from a series of focus groups hosted at the Rockefeller Foundation Bellagio Study and Conference Center in April 2011, with funding from the US National Science Foundation (Grant #0926349), the Institute of International Education, and the International Institute for Environment and Development. The analysis draws extensively on the insights of the 'urban adaptation leaders' who attended, and the organisational team (Eric Chu, Cristina Rumbaitis del Rio, and Shuaib Lwasa), but responsibility for the interpretation of the findings rests with the authors. An extended version of this briefing paper has been prepared for publication in Moser S, Boykoff M (eds.) Successful Adaptation (in preparation).

Further reading

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