THE GATHERING STORM
Will Asia Pacific Cities Adapt to Climate Change?

Global Scenarios 2007
Nautilus Institute and the Global Cities Institute
November 6-7, 2007 at RMIT Vietnam
Ho Chi Minh City

Climate Change Adaptation

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Global Scenarios Workshop Report
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Co-sponsors:
Nautilus Institute at RMIT University
Global Cities Institute at RMIT University

Facilitator: Joan Diamond assisted by Miranda Weingartner

Cover Photos:

Top: Ice Ecosystem Middle: Forest Ecosystem Bottom: Urban Ecosystem
Location: Scenarios meeting room, 2nd floor, RMIT Vietnam Campus, Ho Chi Minh City.
Creator: Lyndal Jones, RMIT Associate Professor, Multimedia, School of Creative Media created a dynamic art event at the workshop that greeted participants as they entered the venue.
Challenge: Composed of melting ice, the participants were challenged to figure out what to do with the melting water—and were told that it would not all fit in the forest and city provided.
Rules: They were given one rule: no water could leave the meeting room.

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What we hope is that people come up with various options that are the ones that the world will consider. In doing so, we are trying to understand the ways in which people are thinking about this issue right now. For the Global Cities Institute, this is a starting point for us.
Professor Paul James, Director, Global Cities Institute

I. Introduction

Global climate change is upon us and accelerating. That is now the unambiguous and direct message from climate change science, modeled quantitatively to an ever finer resolution for each region of the planet. As a result of this climate change, complex direct and indirect impacts on every aspect of human existence can already be seen. Humans in every society and from all walks of life are becoming aware of this change, and evidence is accumulating rapidly that many of the resulting impacts will stress societies in all sectors in profound, possibly devastating, ways. Some of these changes will be similar to those that humans have coped with in the past—droughts, flooding and storms, for example. But others will result in qualitative shifts and even system collapse as thresholds are reached and exceeded—for example, in habitat and species loss, or wholesale loss of territory due to inundation from sea level rise and storm surges.

Cities are crucibles of human activity and creativity. Some cities are far more vulnerable to climate change than others, and some are far better equipped by virtue of wealth and institutional capacity to adapt to the impacts of climate change. Some cities may even benefit from climate change, because of shifts in trade competitiveness, or improved weather and lower energy bills. But most urban dwellers will experience climate as a new source of insecurity, whether it be via direct impacts such as flooding and extreme weather, or more indirect pathways, such as the interaction of climate-induced ecological successions that interact with air pollution to affect those sensitive to allergens. The poor already suffer the most from climate change, and they are likely to bear the brunt of change over the coming decades.

Cities and their populations have direct responsibility to adapt to these impacts, not least because most adaptation is local by definition. Adaptation is now firmly on the global climate agenda, and cities are now established players in global climate politics and policy-making.

This workshop, a joint activity of RMIT University's Global Cities Institute and the Nautilus Institute at RMIT and in San Francisco, set out to explore how cities in the Asia-Pacific region might adapt to climate change, and in particular, whether they might collaborate with each other in ways that cannot be anticipated by states and might prove critical to successful adaptation. The workshop was held with the support of RMIT Vietnam on its campus in Ho Chi Minh City. The participants grappled with the issue of climate change from many different perspectives and identified a research agenda that could feed into policies and actions at many levels within and between nations and societies.

This report is divided into five sections, starting with this introduction. Section II explains the scenarios method used in the workshop, and describes some of the driving forces used to define the scenarios.

Section III outlines the eight scenario narratives created by the participants. Section IV analyzes some of the policy- and action-oriented implications of these eight narratives. Section V provides an overview of the climate challenge for cities in this region, and addresses their ability to weather the gathering storm of climate impacts.

Based on the scenarios, we are optimistic that it is indeed possible for cities in this region to adapt to climate change. The challenges identified by the participants were immense, but at critical junctures they found ways to overcome many of the most daunting obstacles. In this sense, the outcome of the workshop was to immediately inspire participants to carry home the message that the time to adapt is now, and that one of the best ways forward is for cities to collaborate.

This workshop was the result of a large cast of characters. Joan Diamond, Peter Hayes, Scott Bruce, Miranda Weingartner, Tim Savage, John Withers, Jonathan O'Donnell, Jodi-Anne Smith, and Jane Mullett all played critical roles in organizing it. Patrick Griffiths from RMIT Vietnam also provided essential support. The workshop could not have proceeded without the support of Professor Michael Mann, director of RMIT Vietnam, and the vision of Professor Neil Furlong, the Deputy Pro Vice Chancellor for Research and Innovation. We were also grateful for the funding provided by the Korea Foundation to this annual Global Scenarios workshop.

The workshop was facilitated by Joan Diamond supported by Miranda Weingartner, both from Nautilus in San Francisco. They were especially grateful for the efforts of the University staff and a team of RMIT Vietnam students who did everything from hauling ice to setting up rooms. We were also fortunate to have the dynamic climate art work installed by Lyndall Jones from RMIT; and to have received a cultural performance from Vietnamese performing artists.

Finally, the workshop was conducted under Chatham House Rules and no participant is responsible for the contents of this report which was written by Joan Diamond, Peter Hayes, Jane Mullett, Felicity Roddick, and Tim Savage. We do not purport to accurately reflect all the events (and sometimes commotion) that took place at the workshop itself. As the participants will attest, too much happened too fast at this event for that to be possible. Nonetheless, we hope that readers find the report enlightening.

II. WHAT ARE SCENARIOS

2.1 The Scenarios Method

The Nautilus Institute focuses on developing and sharing tools that increase the resilience of states, organizations and individuals in policy and planning in a variety of different possible futures. The Institute has used the scenarios process to examine a number of different narratives of the future in order to better understand the driving forces of today, and develop the means to work towards preferred futures. We use scenarios to order our thoughts amid uncertainty and build common ground among differing perspectives. In examining a number of different futures, scenarios impel us to reconsider our assumptions, challenge conventional wisdom, and explore creatively - and pragmatically - our options. Previous scenarios workshops have explored the future of Sino-American relations, Korea-American relations, nuclear next use, North Korean nuclear conflict resolution, corporate social responsibility, and sustainability in the Asia Pacific region.

The Nautilus Scenarios workshop allowed participants to explore the challenges of global sustainability across borders. The project aims to develop linkages across national- and sectoral-boundaries, so that political leaders and NGOs from different cities can work together on shared interests, support each other, and collaborate on common problems and strategies.

2.2 Driving Forces

The world is faced with three ways of dealing with climate change: these are to mitigate, to adapt, or if nothing is done, to suffer from the impacts. Climate change is a classic global problem with many dimensions, levels, and interconnections to other global problems. Some of its driving forces are true "wild cards" and cannot be anticipated in advance—for example, the end of the former Soviet Union significantly reduced greenhouse gas emissions due to the Russian Federation's economic contraction.

But many of the driving forces can be specified, and some will clearly have a powerful effect. A short list of possible driving forces—some highly predictable, and some very uncertain in both scale and likelihood—are as follows:

Social Factors:

- Health
- Pandemic.
- Population/demographic.
- Working/living conditions – labor or leisure
- Consumption style (e.g. traditional market v. big supermarket change)
- Fear, response to disaster and catastrophe. (People recover, live with danger).
- Public awareness, behavioral changes, positive international examples. (How much are people in denial, how open are responses).
- Religious changes.
- Organizing on the basis of fear, instead of on the basis of possibility.
- Massive sudden migrations - climate refugees are certain, but where they'll go is uncertain.

Technology

- Technology (alternative energy).
- Breakthrough technology on adaptation. Way of providing electricity, knowledge/information.
- Energy resources – new, alternative.
- Severity of pollution.
- Planetary colonization.
- Internet development.
- Removal of grid/distributed energy development.
- Peak oil.

Governance

- Government leadership.

- Inter-city networks.
- Nuclear next use.
- Economic/financial crisis.
- Trade.
- Environmental law and regulations.
- Unintended consequences (black markets etc.).
- Economic incentives and rewards.
- Politics – election, interest groups, policy communities.
- Level of violence w/in and b/t countries.

Whatever the ultimate effect of these driving forces, one thing is clear: climate change most threatens the poorest people in society. The rich will find a world of rapid climate change to be more expensive, inconvenient, and uncomfortable. Many of the poor will face death and disease and, at minimum, more miserable lives on a daily basis.

Typically in a scenarios workshop, scores and sometimes hundreds of driving forces are identified. The task is to determine which of these are powerful in relation to the focal question; and which are also uncertain. When we are focused on big picture outcomes in a complex world of inter-connected global problems, we are not very interested to spend valuable time discussing what is either highly predictable (and therefore already at least well-known) or not very potent in affecting the ultimate outcomes in the future. Rather, we are looking for powerful uncertainties that we may not have thought about and even may make us feel very uncomfortable.

Thus, in scenarios, we seek to construct narratives about the future that are not only plausible, but combine radical uncertainty with high impact. Stories built this way are likely to be highly divergent, and to challenge our limited knowledge and ability to comprehend complexity, thereby alerting us to possible threats and opportunities, and suggesting ways to prepare against being ambushed by these powerful, uncertain forces.

2.3 The Ho Chi Minh Workshop

The participants at the workshop came primarily from Australia and Vietnam, but also from Japan, Korea, China, Thailand, Indonesia, Fiji, Canada, and the United States. The full participant list is provided in Attachment 1. The group was culturally diverse, and offered a rich palette of disciplinary training and life experiences.

The focal question posed to the workshop was developed by the organizers well in advance so that participants could think about it while reading the background materials before they arrived. The focal question for this workshop was:

Will Asia-Pacific Cities Adapt to Climate Change?

This question left open the possibility that climate change could overwhelm cities; that some cities might gain from climate change as "winners" while others might lose badly, no matter how much they try to

adapt. The focal question was designed to pose the question in a stark manner without presupposing any particular value or normative goal.

III. GATHERING STORM SCENARIOS

Split into seven *Nhom Nho* or small working groups, the participants reviewed the driving forces that would affect the answer to the focal question. Based on the driving forces that they judged to be both powerful and highly uncertain, they developed six scenarios.[1]

3.1 THE LOTUS COALITION SCENARIO

Lotus Coalition Capsule Narrative: In 2008**,** Hilary Clinton is elected President of the United States. She undertakes a goodwill tour of Asia and plants a "friendship tree" in Ho Chi Minh City to symbolize the political will to merge environmental concern with economic growth. Unfortunately, political will is insufficient; market forces continue to dominate the landscape and environmental degradation coupled with a widening gap between rich and poor forges ahead. A local Vietnamese group called the "Lotus Coalition" emerges to challenge this status-quo, advocating "local solutions to global problems". They gain in popularity among a wide range of Vietnamese across political divides. Youth wear the Lotus logo on clothes and school bags, and the logo appears in graffiti on construction fences. The nationalistic

[1] One group was so divided in relation to core issues that it could not generate a common narrative and instead, spent its time discussing the need to listen. As one Vietnamese participant stated cogently of their work: "First, when we work on adaptation, maybe we first need to adapt to each other."

flavour appeals to the old guard. Scholars find a home and their research is used to support the Lotus mandate.

2010 sees the world join for another Climate Change Summit. Rapid development in Asian nations is blamed for the increase in global warming. Many developing nations demand that the more affluent nations pay for "green" technology transfer. The United States is in recession and refuses to sign on. The Conference adjourns without agreement. Worldwide, newspaper headlines express a growing outrage at the impotence of states to manage an increasingly anxious population.

New crises in the Middle East send oil prices past $150/barrel. Meanwhile, Vietnam unveils a biofuel plan. The construction of the first plant in south HCMC causes some dislocation and disillusion among the dislocated population. The Lotus Coalition advocates for the dislocated. The government finds itself held accountable for making sure the biofuel plant benefits all equitably, but this is a tall order. The private sector begins to take control over the much of the energy economy, and by 2016 inequality in Vietnam reaches a new high. By 2018, rising sea levels threaten coastal development plans and resulting local unrest is increased by the impact of a devastating typhoon. Cross-border refugees create a repatriation problem with China. Finally, in 2025, a UN emergency conference is convened to find a way to stabilize the flow of climate refugees, possibly by massive technology exports and development assistance.

Lotus Coalition Main Themes: The main themes in this narrative were:

- Emergency involving large numbers of people whose lands were displaced, confiscated for infrastructure, and finally, inundated by sea level rise, floods, and typhoons.
- Ineffective governmental response to these crises.
- Private sector firms and NGOs were key responsive actors
- The non-governmental sectors led climate adaptation, for better or for worse.
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As the Lotus working group concluded, "In our narrative, we had a spike in oil prices which leads a major foreign multinational company to invest in biofuels infrastructure in Vietnam. This biofuel company does not incorporate some of the climate change adaptation technology that is required for Vietnam. In the end, there is inundation from floods and adaptation technology is adopted in the biofuels sector only after the disaster. One of the implications was how to get technology and knowledge transfer from business to business, or from business to government, and how to address some of the inequities that are created by private sector investment. In our intervention, we felt that we needed to have some kind of solid regulatory framework, and to develop the rising concept of corporate social responsibility…so that governments attract private investment in a way that is also conducive to climate change adaptation technology transfer."

Lotus Coalition Implications: Civil society and strong NGO leadership may result in effective immediate adaptation, but in the long run, they are unable by themselves to solve the problem. In particular, local NGOs need a supportive environment in which to operate effectively. More robust government-NGO partnerships will be needed for adaptation to succeed, and more flexible NGOs and coalitions with like-minded groups will be helpful.

Lotus Coalition Research Agenda: The following research topics were identified from this narrative:

- Social mapping that can contribute to understanding potential large-scale redundancies.
- How to build up the skills and expertise of NGOs
- How to get resources from governments to appropriate companies and to needed areas.
- What works in regulation, corporate governance, technology transfer.
- What is the market for technology in adaptation?
- What will motivate the private sector to become more involved?
- What kind of regulatory framework is needed to ensure that private investments in adaptation result in public goods, not just private profits?

3.2 FACTOR 20 SCENARIO[2]

Factor 20 Capsule Narrative: ***"****I'm now 70 years old. My two children are older and wiser. I studied at Harvard, and thought then that Americans had all the answers, but they taught me to believe in myself and my people. Throughout life I've taken advice from people in the Asia-Pacific region because they understand my region and my culture, which is why we have F-20; the green city."*

It's 2025, and the narrator begins telling her story… It began way back in 2009 with the signing of what later became known as the "Bali Agreement." In 2011, Southeast Asia was hit by a season of unstoppable monsoons. Ho Chi Minh City was flooded; it seemed to never stop raining. In the ensuing chaos, a

[2] Factor 20 is a European idea that aims to radically increase resource use efficiency by twenty-fold-mainly through strategies of 'dematerialisation' or turning material utilities into services.

virulent strain of cholera broke out and enormous stress generated a wave of creative innovation. In 2014, we developed the F-20 philosophy with four basic principles:

- City planning and design. Eco-efficiency aims for 95% decrease in use of resources despite a twofold increase of population. Housing concentration, transportation improvements,
- Cradle-to-cradle technology; every part of the building used and re-used.
- Everyone uses only what they need.
- Equity for all.

In 2016, the narrator, by now the new chair of the People's Committee of HCMC, is charged with explaining the importance of F20 philosophy to the national government. In 2019, a Commission is established to examine best practices in an attempt to overcome political conflict in the aftermath of the years of climate-induced catastrophes. The narrator is appointed Minister of Construction. By 2020, Ho Chi Minh City is so attractive due to the implementation of F-20 that Australians are moving to Vietnam to escape the heat and drought in their land!

By 2022, the process of *desakota* or in-situ urbanization is accelerating in Vietnam, and a full-scale rural revitalization is underway.

By 2025, the narrator is ready to hand off to a rising generation of new leaders. "It's up to you now," she says, "I'm old, and I'm gray, and I don't have the energy to do any more."

Factor 20 Main Themes: In this narrative, the four main drivers generated four major themes that were braided into the narrative. These were:

- extreme climate events
- mass migration
- intercity collaboration
- domestic/foreign investment in urban regions

The narrative began on an optimistic note when the world's major emitters signed the Bali protocol. But then extreme climate events devastated cities, eliciting a mobilization of governments and civil society in response to the ensuing disasters. The macro-regional issues overwhelmed existing capacities and political tensions emerged within governments, and between governments and civil society, as well as on the international level. With time, tenacity, and seasoned leadership, these challenges strengthened both governmental and civil society organizations and increased resilience at a community level via better organization and education.

Factor 20 Implications: Overall, this narrative suggests that the initial efforts to build adaptive capacity focus on good governance, dealing with displacement, aligning desired outcomes, and dealing with the rich/poor divide. In particular, the narrative argues that:

- Agencies should develop metrics of adaptive capacity which should be a key organizational performance indicator. Local governments in particular should be resourced based on how well they deal with these challenges because without effective local government, adaptation will be limited to centralized response to catastrophic events rather than building local resilience.

- Metrics of adaptive capacity should recognize and reward transparency of decision-making, and practices that lead to greater inclusion/collaboration with civil society.
- Adaptation will entail dealing with massive population displacements. It is critical to document and remember who and what was there before displacement and where people went.
- Adaptation should foster interventions that clarify and enforce the basic rights of affected people.
- Micro-credit is likely to be an essential method whereby local adaptation is nurtured at the household and community level.
- The tax system will need to be amended so that it charges and reflects real costs, including human and environmental externalities associated with various types of adaptation.
- Subsidies should be used to promote adoption of best-practice outcomes. Cities might also undergo peer review and be ranked in public evaluations of adaptive capacity for investors, livability, etc.
- Social insurance and community health service facilities will need to be strengthened greatly if communities and cities are to adapt to severe climate change.

Factor 20 Research Agenda: The following research topics were identified from this narrative:

- The need to understand better how to monitor or evaluate governance systems that pertain to climate adaptation.
- The need to develop new, city-specific environmental standards and guidelines.
- The need to develop adaptive planning and models for buildings, developments, and vegetation zones.
- How might investments in climate resilience improve city-level competitiveness in global marketplaces for financing, investment, and trade.
- Documenting best-practice cases and how these can be applied to other areas.

3.3 GREEN CITY SCENARIO

Green City Capsule Narrative: In 2009, most people in Ho Chi Minh City don't want to think about climate adaptation or having to relocate if storms and sea-level rise overwhelm the city with flooding. In 2009, RMIT launches Vietnam's first disaster adaptation course, adapting western models and drawing on Vietnamese case studies and experience. The narrator, Thi-a, a young Vietnamese women, enters the course and after graduating, becomes a world expert on climate disaster response.

In 2011, she's married and has a child, the same year that there's a disastrous cyclone and unprecedented flooding in the Mekong Delta, and blackouts that seem semi-permanent. The market for houseboats booms in Ho Chi Minh City. Her family is trapped in one of the flash floods in 2015 in which her husband and child are killed, and she finds herself alone and isolated. She decides to go overseas for a year. Meanwhile, serious thought is being given to relocating low-lying Ho Chi Minh City to a new location that is less vulnerable to climate impacts.

Youth step forward in the relocation process, electing our heroine as the leader of a community coalition along the way, and they bring a self-organizing, networked order and vision to what was otherwise a chaotic, haphazard process. By 2017, a new "green city" is built based on a Chinese model. The Youth Union headquarters is one of the first buildings established in the new city, well before most things are built there. Thi-a is the de facto public "face" of the Youth Union.

The almost permanently flooded Mekong Delta due to sea level rise is developed as an integrated wetland with massive replanting of mangroves to provide a buffer against storm surge and with dyke-protected

marinas for fishing vessels. The youth movement does not stop when relocation is more or less complete, but creates a new, vital Vietnam Youth Movement that is independent, activist, and uses mobile technology to organize its various elements. They often collide with vested interests, including those competing to be green and get rich, and from small towns seeking to be the center of relocation.

An international green cities alliance is formed, led by the new relocated city mayors and the international agencies that support their establishment. At the local level, as more and more cities are built for rapid relocation of coastal settlements, a semi-permanent class of itinerant builders, mostly displaced persons from the eco-disaster, are moving from construction site to construction site, often across borders. For all intents and purposes these people have no real home except their current work site and they form a transnational underclass of adaptation workers.

In 2022, Manhattan is largely submerged by rapid sea level rise. The United States becomes isolationist and absorbed in its internal and domestic crises. As Asian cities and societies adapt rapidly to climate change, Asia finds itself in a leading role, offering other parts of the developing and re-developing regions models of climate resilient development and cities.

Of course, new problems erupt as rich people move into these green cities, and the poorer people are displaced, leading to slums rising on the cities' outskirts. A new chapter begins in the history of climate adaptation as cities struggle with how to deal with poverty in the midst of sustainable urban infrastructure. The presence of new slums raises fundamental questions about the meaning and values of green cities, because biodiversity around the city is intermingled with shanty towns, and the dislocated populations defined by their poverty are reminders to those who control the core assets of green cities that dispossession, dislocation, and despair are the fundamental origins of the need for sustainability.

Green City Main Themes: This narrative addresses many themes associated with the challenge of urban adaptation with a focus on the uncertainties of disaster, construction, and response. The narrative gave primary consideration to:

- Food, shelter, energy, fear of destruction, youth groups, relocation,.
- Implications of relocation and dislocation for employment, refugee status, risk management, and social problems and stresses that require major public responses.
- Planning, funding, and integrated relocation led by the government and civil society sectors

Green City Implications: Overall, this narrative suggests that events may move so fast as to overwhelm unprepared governments and that resilience will emerge from bottom-up society-wide responses rather than be super-imposed in advance from top-down. The group noted of its relocation narrative: "We were focusing around all the very physical, tangible needs, but then there was all the complex social reality of what happened afterwards. And therefore, how do you start planning for it before it becomes a necessity-- for the long term complexities, not just the short-term tasks. You are given the license to dream them up then lapse back into the realities."

The narrative was centered on the idea of moving a whole city before a disaster, and followed by the discovery of just how enormously complex that would be—although climate projections suggest that such relocation is likely to be necessary and is not at all a fantasy. Yet human history is short on examples of wholesale urban relocation.

A second, counter-intuitive theme, arose from the economics of reconstruction of the new green cities. As the group itself noted, "Oddly, these disasters could be a good thing in a lot of ways for the people at the very bottom of society. And the very rich probably would be able to weather things just fine, as long as not too much of their net worth was tied up in real estate. It is those in the middle section of society who are going to get really beaten."

The specific implications noted by the group included:

- Major disasters impose enormous uncertainty and outcomes cannot be predicted for planning in advance.
- Chain reactions of linked events and outcomes quickly affected every aspect of existence including food, shelter, fuel, and disease, and thereby generated widespread fear, grief, and psycho-social trauma.
- Adaptation came from innovation in response to enormous social stress, particularly from youth who had new, networked technology that enabled them to draw on ideas from all over the world and to respond by swarming around problems as they emerged.
- If relocation is a real possibility in response to climate threat, this possibility should be raised early and the community should be prepared early. Defense was a natural first inclination for those born and raised in a city overwhelmed by climate change and other related problems; but this should not preclude consideration of relocation. Adaptation on this scale cannot be done well 'at the last minute.'

Green City Research Agenda: The following research topics were identified from this narrative:

- The impact on labor forces and markets is critical in a large-scale relocation as occurred in this narrative. The links embodied by refugees, both past and in the living present, are a crucial dimension and resource for implementing a successful relocation and transition to a more resilient city.
- Many psycho-socio problems will occur in such an adaptive response and social service agencies, both official and private, are likely to be unprepared and overwhelmed for the mental health problems that will arise.
- Many businesses will shut down and trade patterns will be disrupted, leading to loss of income and reduced food availability, with follow-on effects on the tax base for green cities when they are established out of a large-scale urban relocation.

3.4 NUTRIA SCENARIO

Nutria Capsule Narrative: This narrative was set in the country of Nutria. It is a deltaic country with a dense and growing population on its fertile and arable inland territory, but also highly populated on its coastline. It has high levels of trade and migration with neighboring states and it depends heavily on foreign investment, although it is largely self-sufficient in primary resources including energy. However, it is prone to typhoons, and many aspects of its physical and social infrastructure are stretched to their limit already by rapidly increasing population.

Foreign investors build dams and invest in timber extraction which creates a vicious circle of erosion and deforestation. In 2013, a Nutrian citizen develops a combined low-grade heat solar desalination and sterilization technology that is enormously potent in slums in reducing waterborne disease and providing clean drinking water to hundreds of millions of people. For this innovation, he is awarded a Nobel Peace Prize.

In 2015, a deluge of rain leads to rivers bursting their banks and flooding almost every Nutrian city, and in spite of the new desalination-sterilization water technology, cholera breaks out. Energy is now in short supply and riots lead to an insurrection that topples the government and installs a new regime committed to achieving 50 percent renewable energy supply in three short years—by 2018.

The government pulls in the Nutrian scientist. He leads an international research and development effort drawing primarily on scientific and technical expertise already in developing nations but previously fragmented and disconnected. They create an integrated coastal adaptation plan that has social, technical

and institutional elements that focus on massive mangrove planting, and harvesting of mangroves for multiple products including fast-growing biomass for biofuels, reestablishment of spawning grounds for fish stocks, and recreation of buffers to absorb the shock of advancing storms.

This program proves to be hugely successful and in 2025, wins a global UNDP award for climate adaptation as a global best practice model for replication around the world.

Nutria Main Themes: This narrative addresses many themes associated with social learning in response to ecological and social pressure. These include:

- Pressures on the government to respond in spite of limited capacity in poor countries like Nutria.
- Maladaptive actions taken under the pressure of events and given limited information or understanding of the nature of the disasters befalling Nutria.
- The positive adjustment to the initial failure and openness to rapid reformulation of policies to achieve resettlement of large populations and to stabilize fragile coastal zones.

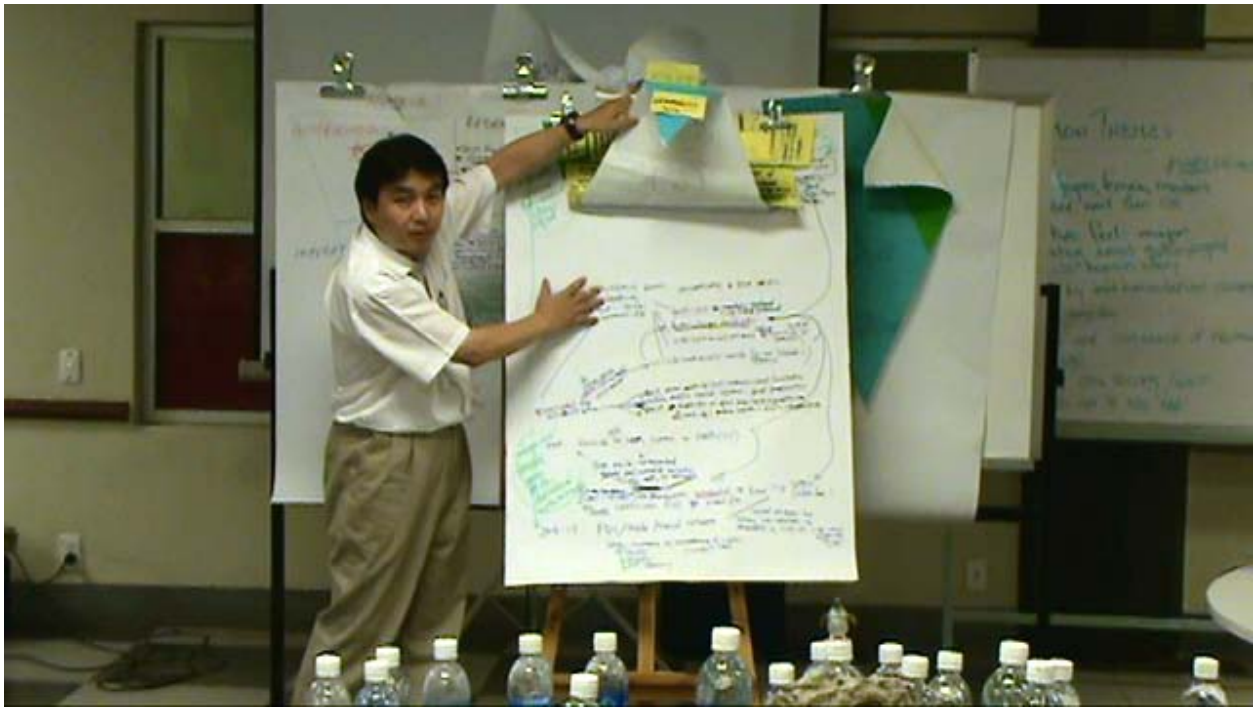
Nutria Implications: Overall, this narrative suggests that governments will remain central to climate adaptation, especially in developing countries. Governments will provide much of the essential vision, resources, information and capacities for dealing with climate challenges. Some specific implications noted by the group included:

- The need to avoid maladaptive responses based on inappropriate action plans, simple lack of awareness or information about the extent of deforestation, etc.
- The probability that affected people left to fend themselves will act to survive, often in ways that destabilize governments and transgress established norms of behavior.
- The fact that what happens upriver always affects what happens downriver; what happens in the coastal zone at the ocean's edge affects what happens inland.
- Entire cultures may disappear in the coastal zones and islands of the Pacific if we do not act now.
- Governments need to anticipate climate impacts and undertake master planning in advance, not just reacting after the fact of climate disasters. Partnerships are needed at all levels, as is participatory education and engagement.

Nutria Research Agenda: The following research topics were identified from this narrative:

- What is best practice in disaster management and urban climate adaptation?
- What are the soft (behavioral, cultural, institutional) versus the hard (engineering) options, and what do we already know as to which options work best in which mixes?
- How can successes be replicated and learning across borders and communities be supported?
- As adaptation is undertaken, what monitoring and evaluation is needed to determine success or failure of the steps taken**?**

3.5 *VU BAO* – VORTEX/STORM—SCENARIO



***Vu Bao* Capsule Narrative:** *Vu Bao* begins with a BBC news report suggesting that the Kyoto Protocol is collapsing. In 2009, the global financial system collapses, leading to mass unemployment. In southern China, the Chinese Communist Party loses grip over local government decisions and after much protest at the local level, nuclear power plants are shut down in this area, affecting the national electricity distribution system.

In 2013, a genetically engineered bio-terror outbreak occurs in China, coming from unknown aggressors. Launched through domestic poultry, it quickly crosses over into the natural bird populations and over the few weeks that it takes migratory birds to fly from one country to another, a pandemic of avian flu erupts in many cities. In 2014, poultry are banned in Chinese cities due to bird flu, and an acute protein shortage ensues in urban diets.

Naturally, scientists everywhere mobilize to figure out how to overcome this pandemic and billions of dollars in research contracts are given out to big research institutions in many countries. Ironically, a 45 year old Muslim woman running a tiny non-commercial research laboratory in Jakarta designs and produces a bio-engineered vaccine. With the bird flu under control, women emerge in positions of power in southern China as the Communist Party regains control in the region.

A wave of technological innovation takes place in response to rocketing oil prices, including a "super-soy" from South Korea and many types of intelligent infrastructure, as well as a series of smart materials that create virtual mobility in houses, and lead to a rapidly decreasing per capita use of resources at a global level.

Households, not global corporations, are in command of local economies based on these technologies. All infrastructure is now inter-connected via the Internet. Materials can analyze their own environment and respond intelligently. Almost all equipment has been miniaturized due to the convergence of biotech with nanotech and biotech in combination with information technology.

As oil has been devalued over a few years, the petrodollar states are in a social and economic crisis. With the collapse of petrodollar recycling and the predominance of local economies, houses trade directly with each other rather than relying on long-distance markets.

***Vu Bao* Main Themes:** This narrative addresses many themes associated with disruptive technology that rapidly changes the cultural and institutional framework for individual and collective behavior. On the one hand, the inter-state framework of the Kyoto protocol collapses, and a pandemic erupts that co-joins human terror with a climate-induced shift in the transmission of avian flu. On the other hand, local cities and institutions step into the breach caused by the decreasing salience of states to actual survival at the local level, and intellectuals—especially scientists—become key factors in solving the pandemic crisis relying on civil society networks rather than states or markets. This is an optimistic scenario.

***Vu Bao* Implications**: Overall, this narrative suggests that innovation often comes from surprising sources and is difficult to orchestrate via bureaucratic structures. Most universities were found to be unresponsive to the pandemic crisis (the exception is RMIT-Vietnam!). Instead, a pandemic activates a wave of human creativity that in turn unlocks technological invention that supplies many solutions that were hitherto inconceivable. The networked civil society, diasporic networks, and the young generation are the key to the rapid innovation, and to the even faster diffusion and adoption of the new technologies in this narrative. Attempts by corporations and governments to control the creation and distribution of the new vaccine also accelerates a networked response of intellectuals and scientists across cities and national borders, to ensure that the new vaccine is available to everyone.

***Vu Bao* Research Agenda:** The following research topics were identified from this narrative:

- A global education and research system is needed that addresses global interconnected issues in a highly applied manner. What avenues are open to achieving this kind of education and research system that are not constrained by existing rigid academic hierarchies or funding agencies?
- In the Internet 4 distributed research network, how can virtual tools be used to create new types of public space in which to share ideas and tools; and can language barriers be reduced or removed altogether?
- What institutional basis exists for public vaccines for non-commercial distribution to everyone—as pandemics do not recognize socio-economic status, this is a critical issue for climate adaptation.
- What new revenue generating strategies are available for cities to fund capacities for adaptation?

3.6 SLOW CATASTROPHE SCENARIO

Slow Catastrophe Capsule Narrative: Tuti, a journalist as well as an environmental activist, participates in the Bali Conference, which fails to agree on climate adaptation. She reports this story in her local newspaper in Jakarta and then forgets about it.

Until … two years later, a major flood forces her to migrate from Jakarta to Vietnam. While she leaves her home behind, she takes with her all the memories and emotions of being flooded in Jakarta. She joins a local newspaper and becomes an editor, writing articles based on her experience in Jakarta which are read by some local officials. Faced with coastal collapse due to the threats of typhoons and sea level rise, the local authorities plan a vast forced migration of nearly 10 percent of the coastal population inland to the highlands.

Fear was the driving force for this relocation---fear at being blamed for loss of life and property if the authorities were seen to be doing nothing, but also fear at the unrest already evident in local communities facing the climate onslaught.

Even though relocation is underway, the question remains as to how to relocate such large numbers of people. Many of the displaced people are fisherman who must switch to farming. Thus, basic re-education and retraining of skilled artisans and primary producers is necessary to adapt to the radically different environment in which they find themselves. The flooding of the Delta also causes rice crops and exports to drop to record low levels, further increasing the need to create new job opportunities inland.

By now, Tuti has migrated to Australia, where she becomes a television reporter for Channel 9. She files a story in 2018 that there is a US-EU agreement on carbon trading which raises many questions; questions related to the rules of trade, to possible conflict, to different forms of global governance of the climate system, and to the possibility of a contrary China-led global alliance.

When the inflation-adjusted real price of oil finally hits $300 per barrel, the United States and China start to explore for oil in Antarctica. Australia intervenes in the process because they are trying to explore for oil in the Australian-claimed territory in Antarctica and a standoff takes place.

In the next couple of years, Australia faces a major drought and shortage of fresh water. The Australians propose a water-for-oil deal. Australia agrees to support the United States and China in digging up the oil in their Antarctic territories, even though it is in contravention of the Antarctica Treaty. In return, the United States and China will support Australia by dragging massive quantities of fresh water icebergs from Antarctica to supply water to its drought-afflicted coastal cities.

Slow Catastrophe Main Themes: The group judged this narrative to be mostly negative in outcomes and dominated by adaptive responses at the state level more than by civil society on balance.

Slow Catastrophe Implications: Overall, this narrative suggests that state-based systems of allocating carbon trading rights are likely to be inflexible and prone to failure. Relatedly, in a world in which states (and by implication, global corporations) dominate carbon management decisions, how can transnational moral communities be supported to address the needs of those without power, wealth or income to participate in such a system.

Slow Catastrophe Research Agenda: This narrative led to a diverse set of research questions including:

- How can we avert carbon trading that creates windfall profits and sets up conflicts based on the need to police carbon trade while enforcing compliance with its rules, without reinforcing existing conflicts and institutions already oriented towards violence as a means of effecting policy. Furthermore, how can we avoid free riding?
- How do multiple countries adapt - via trade mechanisms - in ways that are not corrosive of local and city-level adaptation capacities, and avoid competition over adaptive capacities or lesser vulnerability, creating thereby a climate winners-take-all and losers-get nothing world?
- What water supply and management policies, and new sources of water, might ameliorate the emergence of convergent maladaptive practices and politics of the kind noted in this narrative?

IV. MOVING FORWARD

Professor Peter Hayes began the workshop by saying: "In the next two days, you will compress 8087 days into stories that go from today to 2030, a little more than 22 years away."

As one participant stated in the final plenary session, "we came with such a desire to talk about it, such a commitment, such a lively discussion, such a dynamic group, and you know, we have a right to believe that we could reach somewhere, we can do something. We have only two days to work together and to learn from each other."

In two short days, we generated a research and action agenda based on our answer to the focal question: "Will cities in Asia-Pacific adapt to climate change by 2030?" These six scenarios identified no less than twenty-seven distinct research agendas for follow-up from the Gathering Storm Scenarios Workshop. These include social, economic, psychological, security, technological, and even philosophical and ethical questions that emerged from the narratives.

No doubt there were many other themes and research agendas that could have come to the fore. But in this set of six radically divergent scenarios— ranging from pessimistic and tragic outcomes to heroic and highly successful adaptive responses involving individuals, communities, cities and states responding in new and completely unfamiliar ways—we identified a core set of issues that demand urgent, scholarly, and applied research before intelligent anticipatory action can be undertaken.

One measure of the success of the workshop is that even before the end of the second day, Global Cities Institute had reached agreement with a Vietnamese research partner to undertake joint research on green buildings and adaptation in Vietnam, with particular emphasis on the vulnerability of the poorest urban populations.

In the next section, we shift from narrative scenarios to analysis based on the rapidly emerging field of cities and climate change adaptation.

NARRATIVE RESEARCH AGENDAS

Lotus Coalition Research Agenda

1. Social mapping that can contribute to understanding potential large scale redundancies.
2. How to build up the skills and expertise of NGOs?
3. How to get resources from governments to appropriate companies and to needed areas.
4. What works in regulation, corporate governance, technology transfer.
5. Investigate the market for technology in adaptation.
6. What will motivate the private sector to become more involved.
7. What kind of regulatory framework is needed to ensure that private investments in adaptation result in public goods, not just private profits.

Factor 20 Research Agenda

8. The need to understand better how to monitor or evaluate governance systems that pertain to climate adaptation.
9. The need to develop new, city-specific environmental standards and guidelines.
10. The need to develop adaptive planning and models for specific buildings, larger urban developments and vegetation zones.
11. How might investments in climate resilience improve city-level competitiveness in global marketplaces for financing, investment, and trade.
12. Documenting best-practice cases of adaptation and how these can be applied to other areas.

Green City Research Agenda

13. The impact on labor forces and markets is critical in a large-scale relocation as occurred in this narrative. Understanding the links embodied by refugees, both past and in the living present, are a crucial dimension and resource for implementing a successful relocation and transition to a more resilient city.
14. Many psycho-socio problems will occur in such an adaptive response and social service agencies, both official and private, are likely to be unprepared and overwhelmed for the mental health problems that will arise. Understanding how to create resilience in both the population and the social services is crucial.
15. Research into adaptive and resilient trade patterns will help business deal with disruption and loss of income. The projected follow-on effects on the tax base for green cities when they are established out of a large-scale urban relocation

Nutria Research Agenda

16. What is best practice in disaster management and urban climate adaptation?
17. What are the soft (behavioral, cultural, institutional) versus the hard (engineering) options, and what lessons learned exist as to which options in which mixes work best.
18. How can successes be replicated and learning across borders and communities be supported.
19. As adaptation is undertaken, what monitoring and evaluation is needed to determine success/failure of the steps taken?

***Vu Bao* Research Agenda**

20. A global education and research system is needed that addresses global interconnected issues in a highly applied manner. What avenues are open to achieving this kind of education and research system that are not constrained by existing rigid academic hierarchies or funding agencies?
21. In the Internet 4 distributed research network, how can virtual tools be used to create new types of public space in which to share ideas and tools; and can language barriers be reduced or removed altogether?
22. What institutional basis exists for public vaccines for non-commercial distribution to everyone—as pandemics do not recognize socio-economic status, this is a critical issue for climate adaptation.
23. What new revenue generating strategies are available for cities to fund capacities for adaptation?

Slow Catastrophe Research Agenda

24. How can we avert carbon trading that creates windfall profits and sets up conflicts based on the need to police carbon trade while enforcing compliance with its rules, without reinforcing existing conflicts and institutions already oriented towards violence as a means of effecting policy. Further how can we avoid free riding?
25. How do multiple countries adapt via trade mechanisms in ways that are not corrosive of local and city-level adaptation capacities, and avoid competition over adaptive capacities or lesser vulnerability, creating thereby a climate winners-take-all and losers-get nothing world?
26. What water supply and management policies, and new sources of water might ameliorate the emergence of convergent maladaptive practices and politics of the kind noted in this narrative?

V. POLICY IMPLICATIONS AND RESEARCH AGENDA

Globally, cities emit roughly 75% of human greenhouse gas emissions.[3] Cities that have already signed up to one international city climate action program account for about 8% of these emissions.[4] Thus, a substantial fraction of the climate problem originates in cities. Although cities only cover about 0.2% of Earth's land area, more than 50% of the world's population – about 3.4 billion people—live in cities.[5] Thus, climate change will affect more people in cities, directly and indirectly, than anywhere else. Similarly, many of the responses and solutions will arise in cities. Cities can also link local impacts with local action – where all adaptation must take place.[6] In short, the climate battle will be won or lost in cities; and cities must be prepared to lead given the weak and inadequate response to date by states and markets.[7]

Most cities are largely unprepared to respond and adapt to climate change. To date, relatively few cities have investigated locale-specific biophysical impacts in any depth, or at scales and time frames salient to current land use and planning activities.[8] A survey by the Sydney Coastal Councils Group in Australia, for example, found that less than 30% of councils refer to climate change in planning and management policies or had assessed climate risk or developed hazard mitigation strategies, and more than 60% had no plans to do so.[9] Nonetheless, many cities are exposed to relatively high levels of climate change. Those located in low elevation coastal zones that are below 10 meters above sea level comprise a small fraction of the world's land area, but are inhabited by roughly 10 % of the world's population, or about 600 million people, and an even higher fraction of its total urban population.[10]

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[3] D. Hoornweg, "Cities and Climate Change, the World Bank Perspective", unpublished presentation, Bellagio, October 2, 2008. This figure is contested and seems to be based on the International Energy Agency's estimate that cities account for about 75% of energy use and related emissions, which is only a partial accounting of greenhouse gas emissions, unadjusted for the global warming potential of different gases. Personal communication, Nigel Jollands, IEA, November 17, 2008 and chapter 8, *World Energy Outlook 2008*, at: http://www.worldenergyoutlook.org/docs/weo2008/toc.pdf. David Satterthwaite *et al* argue that the figure is more like 40% in "Climate Change Cities Are The Solution, Not The Problem," September 26, 2008, at: http://www.scientificblogging.com/news_releases/climate_change_cities_are_the_solution_not_the_problem

[4] According to the International Council for Local Environmental Initiatives, its Cities for Climate Protection Campaign involves more than 700 local governments world-wide, accounting for ~ 8% of global GHG emissions, at: http://www.iclei.org/index.php?id=800

[5] Data from Table 4, M.R. Hansen et al, "Global land cover classification at 1km resolution using a decision tree classifier," *International Journal of Remote Sensing*, 2000, 21, p. 1350.

[6] Good data is hard to come by, but circa early 1990s, according to C. van Marrewijk *et al*, *International Economics*, Oxford University Press, 2006 (from data tables at http://www.oup.com/uk/orc/bin/9780199280988/01student/zipf), there were about 2,957 cities with 100,000 or more people on Earth in the early 1990s. J. Vernon Henderson estimates that there were 2684 cities with populations of at least 100,000 or more people in 2000 in "Urbanization and City Growth: the Role of Institutions," Economics Department, Brown University, 2006, at: http://www.econ.brown.edu/faculty/henderson/papers/Urbanization%20and%20City%20Growth0406%20revised%20-%20Hyoung0906.pdf Yet another accounting states that there are about 21,905 urban areas containing more than 5,000 people, implying that there are about 18,948 urban areas sized between 5,000 and 100,000 people. See data tables, Global Rural-Urban Mapping Project, SocioEconomic and Applications Data Center, Columbia University, accessed February 6, 2009, at: http://sedac.ciesin.org/gpw/global.jsp

[7] Farhana Yamin, *Cities and Climate Change: Lessons for and from London,"* The State of London Debate: 'Tackling Climate Change: What Cities can Achieve', on 12 May 2007, Westminster, at: *http://www.ids.ac.uk/index.cfm?objectId=CB7A0C35-0F08-7EBE-A3366C8C85A04031*

[8] Studies have been done for roughly fifty major cities; many of these are summarized and links provided at AdaptNet archives, at: http://gc.nautilus.org/gci/adaptnet

[9] See T. Smith *et al*, Systems Approach to Regional Climate Change Adaptation Strategies in Metropolises, *AdaptNet* special report, May 2008, at: http://gc.nautilus.org/gci/adaptnet/2008/13-may-2008/

[10] G. McGranahan et al, "The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones," *Environment & Urbanization*, 19: 1, pp. 17–37, 2007; R. Nicholls et al, "Ranking port cities with high exposure and vulnerability to climate extremes: Exposure estimates," OECD Environment Working Paper 1, ENV/WK(1), 2007 at: http://www.oecd.org/document/27/0,3343,en_2649_34361_39760027_1_1_1_1,00.html

Urban Climate Vulnerability

A quantitative comparison of the vulnerability of fifty Asian mega-cities prepared for the Rockefeller Foundation[11] shows how difficult it is to create and use relative risk evaluations of climate change on cities. This study set out to determine, across a range of factors, the relative vulnerabilities of a large set of cities. The authors compiled data for each city for eight types of impact vulnerability (without accounting for the sensitivity of the city to the impact, or to the vulnerability of cities to impacts).[12] These impacts were: increase in temperature; change in precipitation; heat stress; infectious diseases; air pollution; glacial melt; sea-level rise; and coastal storms. The authors summarize:

> *Delhi, India has the highest average risk score, followed by Dhaka, Bangladesh. The next two cities are Ho Chi Minh City in Vietnam (also known as Saigon), and Dongguan, China. It is interesting that Delhi's average score is 3, suggesting that for some of the risk impacts, its risk is low compared to the other cities. It is also interesting that the number two and three cities have no risk impact for which they have the highest risk (a score of 5).It is also interesting that most of the cities have an average score below 2. That suggests relatively low exposure on average for these cities. But, some of these cities, such as Jaipur, India, and Handan, China, have the highest score on at least one risk impact. It is difficult to say which city is at greatest risk. On average, Delhi scores highest and Bandung, Indonesia the lowest. But, the rankings differ quite considerably based on which risk impact is considered. (p. S2).*

This study did not claim to measure anything more than the relative degree to which these cities could be affected by climate change. It does not consider how much a city would suffer from climate impacts, nor the past, current, or future adaptive capacity of a city to respond to impacts. Ultimately, it is not clear what the biophysical exposure to climate change (or to risk, which would require these indices to be translated in each city into cost and probability of cost being incurred) signifies for policy makers, even those at the top of national or global resource allocation.

One way to contextualize urban vulnerability is to use top-down regional climate modeling overlaid with a human vulnerability index, but it is inappropriate to extrapolate from this high-scale estimate of risk to specific cities. This work has to be done city by city with respect to a universal set of basic impact categories such as those shown in Table 1.

In Vietnam, RMIT University's Ho Chi Minh City campus is built on land at risk of flooding from storm surge and sea level rise. One "rapid assessment" of Ho Chi Minh City shows that more than half of the area planned for development is less than 2 meters above sea level.[13] This city is growing rapidly due to industrial growth and foreign investment, and is defended either not at all or by degraded dykes from powerful, cyclonically driven storm surges. The most vulnerable populations in the city already face

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[11] Stratus Consulting, *Screening Asian Megacities to Estimate Relative Exposure to Climate Change*, unpublished report to Rockefeller Foundation, September 11, 2007.

[12] Further caveats: The table also presents average scores across all the risk impacts, applying no weighting of individual factors. Note that application of a cardinal scoring system, in our case applying scores of 0 to 5, as well as no weighting, can introduce distortions. A city with a score of 5 does not necessarily have five times the risk of a city with a score of 1. Not all of the risk impacts will equally affect people." p. S2.

[13] Nguyen Minh Hoa and Son Thanh Tung, *Governance Screening for Urban Climate Change Resilience-building and Adaptation Strategies in Asia: Assessment of Ho Chi Minh City, Vietnam*, University of Social Sciences and Humanities, Ho Chi Minh City, Vietnam, August 2007, at: www.ids.ac.uk/UserFiles/File/poverty_team/climate_change/HCMC.doc

Table 1: **Potential Climate Change Impacts On Cities**:[14]

Issue	Key impacts
Higher Temperatures	
	• Intensified urban heat island, especially during summer nights
	• Increased demand for cooling (and thus electricity) in summer
	• Reduced demand for space heating in winter
Flooding	
	• More frequent and intense winter rainfalls leading to riverine flooding and overwhelming of urban drainage systems
	• Rising sea levels, storminess and tidal surges require more barriers, retreat, or damages
Water Resources	
	• Heightened water demand in hot, dry summers
	• Reduced soil moisture and groundwater replenishment
	• River flows higher in winter and lower in summer
	• Water quality problems in summer associated with increased water temperatures and discharges from storm-water outflows
Health	
	• Poorer air quality affects asthmatics and causes damage to plants and buildings
	• Higher mortality rates in summer due to heat stress
	• Lower mortality rates in winter due to reduction in cold spells
Biodiversity	
	• Increased competition from exotic species, spread of disease and pests, affecting both fauna and flora
	• Rare saltmarsh habitats threatened by sea level rise
	• Increased summer droughts cause stress to wetlands and beech woodlands
	• Earlier springs and longer frost-free season affect dates of bird egg-laying, leaf emergence and flowering of plants
Built Environment	
	• Increased likelihood of building subsidence on clay soils
	• Increased ground movement in winter affecting underground pipes and cables
	• Reduced comfort and productivity of worker
Transport	
	• Increased disruption to transport systems by extreme weather
	• Higher temperatures and reduced passenger comfort on public transport
	• Damage to infrastructure through buckled rails and rutted roads
	• Reduction in cold weather-related disruption
Business and Finance	
	• Increased exposure of insurance industry to extreme weather claims
	• Increased cost and difficulty for households and business of obtaining flood insurance cover
	• Risk management may provide significant business opportunity
Tourism, Cultural Identity and Lifestyle	
	• Increased temperatures could attract more visitors to coastal cities
	• Iconic cultural heritage sites may be at-risk
	• High temperatures encourage residents to leave cities for more frequent holidays or breaks
	• Outdoor living, dining and entertainment may be more favoured
	• Green and open spaces will be used more intensively

[14] After R. Wilby, ”A Review of Climate Change Impacts on the Built Environment,", *Built Environment*, 33: 1, 2007, p. 34, based on London Climate Change Partnership 2002 study cited by Wilby.

immense difficulties from the shortage of affordable housing and chronic flooding. City managers need to not only meet the rapidly increasing short-term needs of the poor, including disaster response and hurricane-proofing of buildings; they must also exert control over land use in ways that are pro-active and overcome rigid and centralized planning systems, as well as confront powerful real estate interest groups seeking cheap land to develop.[15] For this reason, the Global Cities Institute has partnered with researchers at the Vietnam Academy of Social Sciences and the Vietnam Green Building Council to investigate climate adaptation strategies in Ho Chi Minh City for poorer communities

Many studies of urban climate vulnerability do not explain why such vulnerability exists at particular locations. In fact, social vulnerability invariably has strong historical and political dimensions. As one study of cities in India notes,

> *"In Indian cities, vulnerability has typically contributed to overall risk more than hazard exposure has. The most vulnerable urban residents are the poor, slum and squatter settlement dwellers, and those who suffer insecurities. These insecurities arise from: poor governance; the lack of investment in infrastructure and in the commons; and strong connections between the political class, real estate developers and public agencies."*[16]

In the case of many coastal cities, exposure to climate risk is the result of the interaction of many factors, not only those related directly to climate change such as anthropogenically-driven sea-level rise via thermal expansion of the ocean and increased frequency and intensity of storm surge. The location of coastal cities also plays a part, as does poor planning and ineffective urban governance. Similarly, the locational choices of global corporations can add to the risk. In many instances, the exposure to absolute sea-level rise at the global level combines with relative sea-level rise due to groundwater extraction leading to local coastal subsidence.[17] Thus, global climate change is only part of the story of coastal settlement vulnerability to sea-level rise.

Multiple Stressors, Multiple Jeopardies

Urban vulnerability is a complex matter. The International Panel on Climate Change (IPCC) has used the concept of multiple stressors to show how a biological or physical asset may be stressed simultaneously by climate change and some other source (for example, forests may be stressed by climate-induced ecological succession and by acid rain). This approach can be applied to urban populations. As David Satterthwaite and colleagues write,

> *"Unlike other areas of climate change research (e.g. agricultural vulnerability), no systemic methodologies and studies have been developed to understand urban vulnerability in the context of multiple stressors; to address the determinants of vulnerability and poverty in urban areas;*

[15] Do Thi Loan, "Real Estate Market & Residential Housing For The Low-Income In HCMC," no date, at: http://www.tu-cottbus.de/megacityhcmc/index.php?id=64&L=0...ocus%3DblurLink(this)%3B

[16] A. Revi, 'Climate change risk: an Adaptation and Mitigation Agenda for Indian Cities', *Environment and Urbanization* 20 (1), April 2008

[17] D. Satterthwaite et al, *Building Climate Change Resilience in Urban Areas and among Urban Populations in Low- and Middle-income Nations,* prepared for the Rockefeller Foundation's Global Urban Summit, *Innovations for an Urban World*, in Bellagio in July 2007, p. 3; and published as: *Adapting to Climate Change in Urban Areas The possibilities and constraints in low- and middle-income nations,* Human Settlements Discussion Paper Series, online at: http://www.iied.org/HS/topics/accc.html

and to explore the constraints and windows of opportunity (e.g. innovative approaches) to increase the adaptive capacity/resilience of the urban poor." [18]

The poor are particularly affected by the displacement and structural adjustment effects of integration into the global economic system, as well as the extractive behaviours of local political and economic elites and predatory practices. Climate change risks are superimposed on their pre-existing vulnerability due to these social factors. These combined and overlapping risks may be termed "multiple jeopardies" to highlight their social and institutional origins and to distinguish them from multiple stressors that typically apply only to biological and physical risks or ecological stresses interacting with climate change. However, micro-level or urban-wide studies that carefully distinguish between these sources of risk and hazard in relation to climate and globalization-driven processes are not yet available (in contrast to the rural sector that offers some elegantly crafted research work in this area).[19]

Within this urban population, a large fraction, often the majority, live in more or less extreme poverty. The category "poor" is a diverse group with respect to the poverty line, and may be always or usually poor, that is, chronically poor; or constantly or occasionally (transiently) poor.[20] In the low and middle income world, about 0.9 billion urbanites live in poverty according to UN Habitat estimates of whom about 0.65 billion lack adequate water and 0.8 billion lack adequate sanitation.[21] This population – and perhaps even more so, poor rural populations in urban hinterlands – are disproportionately at risk or are vulnerable to climate change impacts. As Dodman and Satterthwaite summarize:

> *The main impacts of climate change on urban areas in the next few decades are likely to be increased levels of risk from existing hazards. For poorer groups, these will present a variety of impacts: direct impacts such as more frequent and more hazardous floods…; less direct impacts such as the reduced availability of freshwater supplies available to poorer groups; and indirect impacts such as climate change-related weather events that increase food prices or damage poorer households' asset bases. In addition poorer groups are disproportionately vulnerable for a variety of reasons, including:*
>
> - *greater exposure to hazards (e.g. through living in makeshift housing on unsafe sites)*
> - *lack of hazard-reducing infrastructure (e.g. drainage systems, roads allowing emergency vehicle access)*
> - *less adaptive capacity (e.g. the ability to move to better quality housing or less dangerous sites)*
> - *less state provision for assistance in the event of a disaster (indeed, state action may increase exposure to hazards by limiting access to safe sites for housing)*

[18] *Ibid*, p. 19.

[19] See, for example, K. O'Brian et al., "Mapping vulnerability to multiple stressors: climate change and globalization in India", *Global Environmental Change* 14 (2004) 303–313; one study that provides glimpses of such analysis is: Marie Claire Langley, "Climate Change and Urban Poverty in Indonesia: Assessing Climate Change Impacts on Poor Communities in Jakarta", M.Sc. dissertation, University of Edinburgh, 2007

[20] Categories are from Hulme, cited in T. Tanner, R. Mitchell, ―Entrenchment or Enhancement: Could Climate Change Adaptation Help to Reduce Chronic Poverty, *IDS Bulletin*, 39, 4, September 2008, p.8.

[21] D. Dodman and D. Satterthwaite, "Institutional Capacity, Climate Change Adaptation and the Urban Poor," *IDS Bulletin*, 39, 4, September 2008, p. 67. Although globally, urban poor in Asia and sub-Saharan Africa dominate the total, estimates of the urban poor at-risk from climate change impacts have not been compiled for OECD or relatively wealthy nations.

- *less legal and financial protection (e.g. a lack of legal tenure for housing sites, lack of assets, and insurance.)* [22]

Climate Threats to Urban Infrastructure

How are cities threatened by global climate change? Table 1 summarizes the array of possible impacts on major cities, which include damage to public health, economic costs of climate impacts, loss of cultural heritage, and a host of other threats. Many of these possible bio-physical impacts on cities are not yet well understood. These impacts are likely to be interactive and multiplicative, not separate and merely additive. Future heat island impacts, for example, may be magnified not only by urban growth but by global climate forcing as well.[23] Allergenic air pollution may be made much worse by climate-induced ecological succession and flooding that increases pollen production by invasive weeds interacting with increased photochemical smog due to heat island and temperature extremes in ways never before experienced.[24]

At an intermediate scale between the whole city and households, impacts on telecommunications, energy, transport, and water networks, on the built environment, and on coastal structures have been anticipated and estimated in only a generic sense and for the most part, at national or state not local or municipal levels.[25] Yet, the costs may overwhelm city level service providers and even raise the prospect of "failed cities".

There are many unfamiliar inter-linkages within cities arising from climate impacts ("climate issue clusters") arising from sheer complexity that may affect the efficacy of policy responses. For example, reducing water distribution losses to rectify shortages due to reduced rainfall in future climates may also reduce water available to trees, thereby affecting the ability of cities to maintain their green infrastructure, itself an important defense against extreme weather.[26] The effects go all the way down to the street level and local security. What design changes will be needed in police vans used to hold arrestees if the number of extreme high temperature days increase dramatically and there are no shade trees under which to park? At the city-wide level (and higher), networked infrastructure may experience cascading failures at critical inter-dependencies between these networks such that one network may bring down linked networks.[27] For example, floods create water-supply contamination, which then impacts on health service networks. Climate change could trigger such chains of events in interconnected networks, or amplify downstream-downwind concatenations.

Adaptive Response and Resilience

One way to approach how cities may adapt to climate change--especially the faster, dangerous end of the spectrum of possible climate impacts--is to examine the history of twentieth century urban recovery from

[22] Dodman and Satterthwaite, *op cit*, p. 69.
[23] C. Goodess et al., "Climate Scenarios and Decision Making under Uncertainty," *Built Environment*, 33: 1, 2007, p. 21.
[24] Harvard Medical School, Center for Health and the Global Environment, *Climate Change Futures, Health, Ecological and Economic Dimensions*, November 2005.
[25] CSIRO, Maunsell Australia Pty Ltd, Phillips Fox, *Infrastructure and climate change risk assessment for Victoria*, Report to the Victorian Government, March 2007.
[26] S. Gill et al, "The Role of the Green Infrastructure, Adapting Cities for Climate Change," *Built Environment* , 33:1, 2007, p. 122.
[27] D. Satterthwaite et al, *op cit*, p. 7.

natural and human-made disaster. Table 2, created by Vale and Campanella, summarizes lessons learned from this experience of recovering from natural and human-made disasters in cities across the world. These axioms point to how urban resilience may develop in response to large-scale, dangerous and rapidly catastrophic climate impacts on cities, at least for those climate-induced disasters that are highly compressed in time.

Table 2: **Twelve Axioms of Urban Resilience** [28]

1. Narratives of resilience are a political necessity.
2. Disasters reveal the resilience of government.
3. Narratives of resistance are always contested.
4. Local resilience is linked to national resilience.
5. Resilience is underwritten by outsiders.
6. Urban rebuilding always symbolizes human resilience.
7. Remembrance drives resilience.
8. Resilience benefits from the inertia of prior investment. [29]
9. Resilience exploits the power of place.
10. Resilience casts opportunism as opportunity.
11. Resilience, like disaster, is site-specific.
12. Resilience entails more than rebuilding.

As Vale and Campanella explain, the recovery and restoration of cities afflicted by catastrophes often takes more than one generation and usually creates a new identity for that city based on recovery narratives that are a source of pride and inspiration. But modern climate-related disaster recovery, whether in response to massive shocks such as Hurricane Katrina on New Orleans, or slow motion disasters due to heat and water stress in cities in Australia, have yet to be documented.

However, creating anticipatory networks and developing foresight among community leaders – a key aspect of complex adaptive systems – is already underway with many scenario dialogues and community level engagements underway in cities around the world. Overcoming the psychological barriers to recognizing the urgency and scale of behavioural and institutional changes needed for successful adaptation is now firmly on the research agenda, alongside the scientific and technical aspects of urban climate adaptation. Thus, in addition to the hard and soft infrastructure research on urban climate change underway at RMIT -- in particular, on adaptive materials for buildings and adaptive water chemical treatment -- the Global Cities Climate Change Adaptation Program has also invested in creating and applying tools for climate scenarios with local communities.

Global Frameworks

Many of the biggest impacts of climate change will not be direct. Instead, they will be mediated by the global trading and financial system, as whole regions, economies and cities find their global market niche undermined or enhanced due to climate impacts. The shift from imports and exports of fossil carbon fuels

[28] Source: L. Vale, T. Campanella, *The Resilient City, How Modern Cities Recover from Disaster*, Oxford University Press, London, 2005, pp. 335-353.

[29] This axiom refers to the power of property rights, the impulse to restore the past, the embedded infrastructure that is difficult to reform, and the place and locational advantages that led to the city in the first place. Ibid, p. 346.

to industrial production of biofuels plus export of captured carbon for sequestration is likely to have a huge impact on the competitiveness of port cities. Such dynamics call for a networked approach between cities rather than relying on nation states and markets to avoid destructive competition during the climate-driven transition that lies ahead. The Global Frameworks project at Global Cities seeks to facilitate the emergence of inter-city networks to nurture cooperative and coordinated approaches to adaptation rather than conflict-based and likely maladaptive strategies.

The research needs related to cities and climate change adaptation are immense, challenging and immediate. This workshop provided many research questions that need urgent attention. The task at hand is to provide research that can assist cities to change in a manner that promotes resilience, provides hope and encourages equity.

Ho Chi Minh City, November 6, 2007

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ATTACHMENT 3: GLOSSARY

Please read this glossary carefully as we will refer to these terms many times during the workshop. These definitions are not "correct"—they are simply the meanings we will use in this context to ensure that we have a common language.

'Asia-Pacific Communities'—communities defined by identity such as: multinational communities (for example, supranational entities such as APEC), sub-regional communities (such as ASEAN), subnational communities (such as cities), transnational communities (such as diasporas), national communities (such as nation-states), sectoral communities (such as a corporate, civil society or state agency transect of any of the above), or combinations of the above communities in networks, with no specific geographic definition of Asia-Pacific in mind as many such spatial scopes co-exist, co-mingle, and jostle for attention, but always used with notion of purposeful, self-aware, collective, norm-based activity that is associated with community at any level, wherever it is located or lived.

'Vulnerability'-- the extent to which communities are potentially affected negatively to internal and external stresses that exceed critical thresholds of change generated by global insecurities over a specific time frame: for example, a hundred-year time-frame from time zero is the minimum time-horizon over which to consider inter-generational equity and much infrastructure. Thus, reduction in vulnerability may be a short, medium, and long-term goal, all of which may demand action in the next 30 years.

'Sensitivity'— the degree to which a community is affected, either adversely or beneficially, by stimuli from global insecurities; in the case of climate change,, for example, including mean climate characteristics, climate variability, and the frequency and magnitude of extremes.

'Resilience'—the technical and social capacities of communities to cope with, and adapt to, the stresses of global insecurities without exceeding critical thresholds of change, beyond which communities suffer a systematic and often catastrophic change.

'Trigger events'—short, sharp events that may be internal or external to specific communities that bring about rapid and transformative changes to the whole system by exceeding thresholds of change to which a system is otherwise resilient. An example is the US bombing of the Chinese embassy in Belgrade during the Bosnian War that instantly degraded the US-Chinese security relationship. Trigger events often imply a cultural system that is predisposed to such change but its denizens do not realize that they are rapidly approaching or already at transformational thresholds. Trigger events often are associated with early warnings that whisper—if only we could hear them—that a dramatic change is underway.

'**Adaptation'**-- a process by which strategies to moderate, cope with, and take advantage of the consequences of global insecurities are enhanced, developed and implemented.

'**Adaptive capacity'**— the property of a system such as a community to adjust …to expand its coping range under existing or future conditions of global insecurity, used here to refer to community actions and institutional responses that are purposeful, anticipatory, proactive, and collective in nature in contrast to coping capacity, used here to refer to community responses that are ad hoc, incremental, reactive and often individual or unilateral in nature.

'Infrastructure'—the hard material infrastructure of human settlements such as buildings, transport and telecom networks, and water systems; and the soft infrastructure that provides the institutional framework and social capital to operate the hard infrastructure.

'**Global insecurity'**— the multiple insecurities (see list in A21 planning document) that are global in nature, that is, they either arise in relation to a shared global commons (such as the international oceans or atmosphere, for example); or require a global response and regulation to reduce or resolve the insecurity (such as trade conflict or allocation of radio frequencies). While universal, human mortality or dog bites are not global insecurities by this definition.. Global poverty, global climate change, global war, global dislocation, global biodiversity loss, and global pollution are archetypal global insecurities. An insecurity is a factor that causes individuals or communities to perceive a threat to their welfare or existence in a fundamental way by overturning the status quo, denying them access to sustainable livelihoods, exceeding critical thresholds of change, denying their cultural identity, etc., as defined by international law.

'Risk and Uncertainty' -- a causal factor (event, process, behavior) that has a known or estimable probability and a finite outcome poses a risk; if the probability is unknown the risk is indeterminate, in which case the outcome is uncertain. A causal factor therefore may be more or less predictable, depending on its probability; and may be more or less powerful (depending on its outcome, should it occur). Outcomes can be positive or negative.

Scenario Terminology

'Scenario' -- A narrative of the future driven by unpredictable drivers, an exploration of unknown conceptual terrain. Scenarios are used to expand insight into uncertainty that ambushes organizations and surprises leaders. There are different types of scenarios: technocratic scenarios that are oriented towards states and planning; anticipatory scenarios that aim to help organizations survive in an uncertain world; and generative scenarios that identify interventions that try to realize values and transform the future, often by embracing uncertainty as a basis of strategy. Scenarios usually have a timeline over which meaningful change is possible. Scenarios narratives should be plausible, internally consistent, and not incredible. Good scenarios often make experts feel uncomfortable because they demand that participants grapple with mind-stopping conclusions that are contrary to many closely-held beliefs about the future. Although fictional, the narratives incorporate highly analytical as well as intuitive thinking. Scenarios are often used in organizations engaged in change processes. They are also used to engage persons with divergent views and colliding perspectives to create a common understanding of a difficult or contentious issue and to build a shared strategy to respond to the challenges in the focal question and scenarios. These are sometimes called "strategic conversations."

'Focal question' -- sets in motion a probing enquiry into the overarching, common theme around which the different, uncertainty-based scenarios will be structured. The focal question is the guiding light of a set of scenarios and every word makes a difference. Focal questions lead to an understanding of who is accountable for responding to divergent outcomes and lead to clear definition of agency--who must act to respond to the challenge that is implicit in the focal question.

‘Uncertainties (as used in scenarios)’ -- in contrast to risk in which a probability can be assigned to an outcome or event, genuine uncertainty is not amenable to probability estimation or assignation. In scenarios, we are interested in exploring the unknown. Thus, we try to put aside the predictable drivers and outcomes and focus instead on highly unpredictable drivers/shapers and outcomes. Defining uncertain drivers/shapers and outcomes is inherently subjective.

‘Branching points’ -- are forks in the road of each narrative where it is possible to make fundamental choices in the evolution of the story and outcomes. Branching points where strategic interventions are possible may be of particular interest, especially in generative scenarios that try to deflect narratives toward positive outcomes in terms of the values embedded in the focal question.

‘Drivers/Shapers’ -- Drivers are powerful causal forces that result in outcomes that bear on the focal question. Thus, scenarios usually incorporate sociological, political, economic, technological, and ecological trends and drivers of such trends. Such drivers shape the future and do not stand alone. The driving force should be named, made as specific as possible (for example, not "Demographics" but "Aging workforce in Japan, Korea, China, Australia"), inhibiting and enabling attributes listed, and links to other powerful driving forces should be noted. How these affect the dominant ways people think is also useful to note as a driver may punch a hole in existing paradigms and let new thinking flood through into a narrative.