

2<sup>ND</sup> INTERNATIONAL CONFERENCE ON

# Urbanization and Global Environmental Change Urban Transitions & Transformations: Science, Synthesis and Policy

SYNTHESIS REPORT



Urbanization and Global  
Environmental Change

The 2nd International Conference on Urbanization and Global Environmental Change  
Urban Transitions & Transformations: Science, Synthesis and Policy

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# Table of Contents

Preface.....	1
<b>Synthesis Sessions</b>	
UGEC Synthesis Session #1 Interdisciplinary understandings of urbanization and global environmental change: Regional patterns, processes and transitions .....	3
UGEC Synthesis Session #2 Urban governance, technology and innovation in an era of environmental change.....	9
Special Session on Livable Urban Futures Transitioning 'Urban' into Future Earth.....	15
<b>Theme 1 Urbanization Patterns and Processes</b> .....	19
Session 40 Urban land teleconnections: From concept to implementation .....	21
Session 52 Urban metabolism: The environmental impact of cities.....	26
Session 53 Urbanization, agricultural land loss and food security .....	31
Session 54 A new science of cities for responding to global environmental change .....	35
Session 67 Forecasting urbanization: Population and land dimensions.....	43
Session 72 Urban weather and climates: Assessments and responses.....	48
Session 79 Drivers and patterns of urbanization: Towards a typology .....	55
<b>Theme 2 Urban Responses to Climate Change: Adaptation, Mitigation and Transformations</b> .....	63
Session 14 Human dimensions of urban heat islands.....	65
Session 16 Building resilience in Asian cities .....	70
Session 25 Contested agendas or aligned objectives? Intermediation and the role of non-state actors in the low carbon urban transition .....	74
Session 26 Urban social and institutional responses to global environmental change.....	80
Session 34 Co-benefits of addressing global environmental change in urban areas .....	85
Session 61 Regional perspectives on urban transformations for adaptation to climate change.....	90
Session 70 Resilience and adaptation strategies for transitioning to a sustainable urban future .....	97
Session 90 Shared learning across coastal cities: Impacts, vulnerability, and socio-ecological responses.....	102
<b>Theme 3 Global Environmental Change, Urban Health and Well-Being</b> .....	109
Session 17 Ecosystem services in support of livable cities.....	111
Session 20 Urban health and global environmental change: Interdisciplinary perspectives .....	116
Session 39 Urbanization, biodiversity, and ecosystem services .....	121
Session 42 Resilience in the urban landscape: Improving human well-being.....	127
Session 64 Influence on urban health in the Global South: Identifying the challenges .....	131
<b>Theme 4 Equity and Environmental Justice in Urban Areas</b> .....	140
Session 44 Footprinting and low carbon urban infrastructure development.....	142
Session 56 Towards livelihood security and social justice: The urbanization, infrastructure and governance nexus .....	146
Session 63 Challenges in the developing urban world: Informal settlements, slums and growing inequalities.....	152
<b>List of Participants</b> .....	159



# Preface

Our global environment is changing and humanity is at the center of these changes. With more than half of the world's population living in cities – a trend expected to continue – we've moved into the Century of the City, where urbanization will continue to be a defining social, economic, and environmental characteristic. How can we urbanize in such a way that the negative consequences are minimized while opportunities are enhanced to create cities that are underscored by principles of equity and justice and promote both human and environmental health? Furthermore, how can cities and urbanization not only be sustainable, but can also be catalysts for global sustainability?

In order to begin to explore and answer these challenging questions, the Urbanization and Global Environmental Change (UGEC) Project was created in 2006 to advance scientific understanding of urbanization and environmental change interactions. It was established under the auspices of the International Human Dimensions Programme (IHDP) on Global Environmental Change and has since transitioned to become a core project of the new Future Earth global sustainability research platform. As a science coordination project, it has established regional networks and an international community of scholars that study the bi-directional interactions and feedbacks of UGEC at multiple scales (global, regional and local).

Over the last decade, UGEC research has evolved to become more multi- and inter-disciplinary, and the presence of urbanization and environmental change issues in the literature has continued to expand. Furthermore, while cities locally and regionally have increasingly become key actors in climate change mitigation and adaptation arenas, internationally, cities and urbanization processes are gaining more attention. Examples include the recent inclusion of dedicated urban chapters in both Working Groups II and III of the IPCC AR5 (Revi et al., 2014; Seto et al., 2014), and the establishment of a specific urban goal

as part of the post-2015 United Nations Sustainable Development Goals.

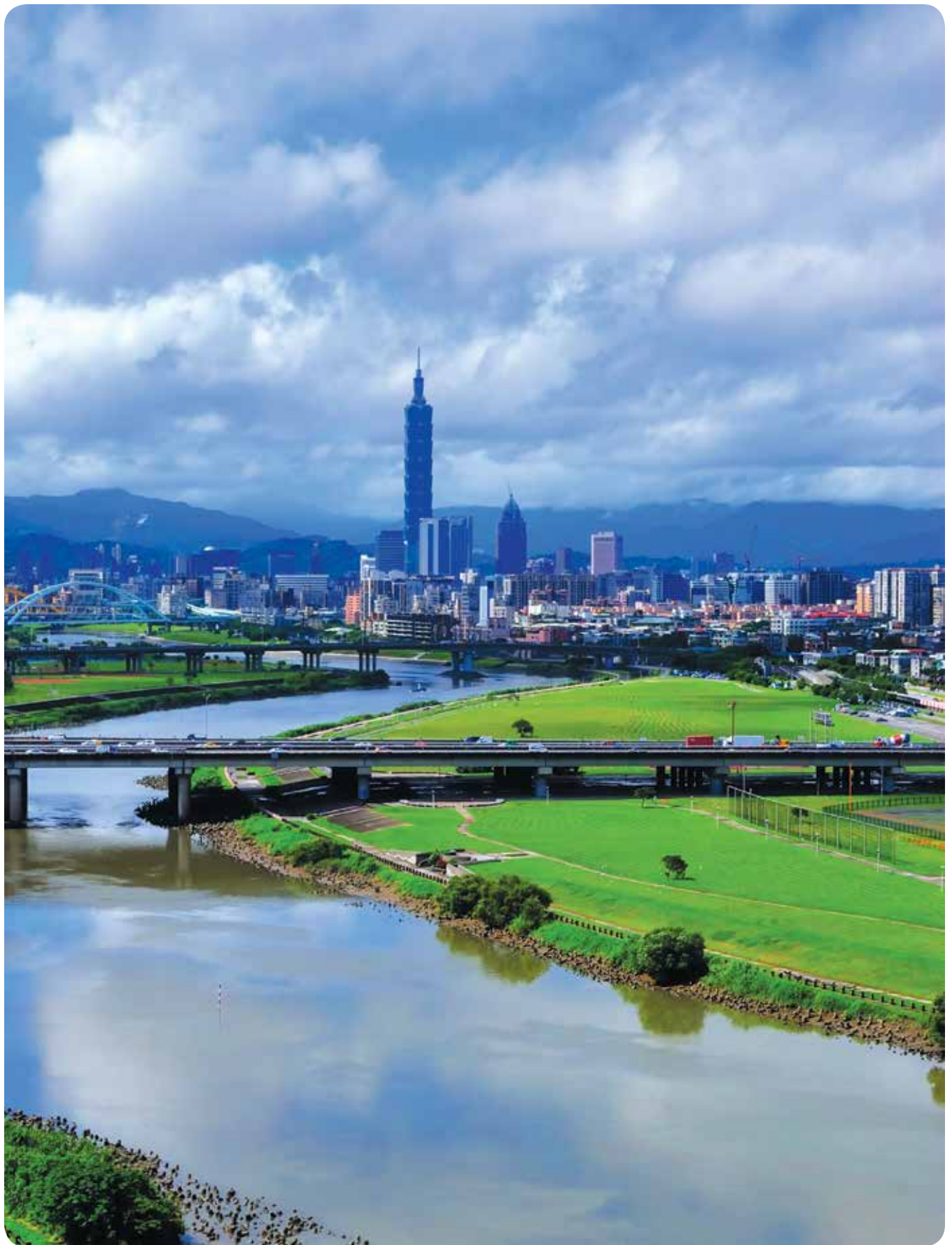
The 2014 UGEC Conference brought together the international UGEC community for a second time since the first in 2010 with two objectives: 1) Synthesize our knowledge of the bidirectional interactions between urbanization and global environmental changes, and to reflect on the key lessons learned; and, 2) Identify transformative pathways for a future urban world that is increasingly complex and uncertain. Indeed, the study and understanding of current urban transitions and transformations requires multidimensional approaches that explore human behavior including lifestyle changes, political and economic agendas, and the adequacy of governance structures to deliver urban sustainability – particularly in a time of uncertainty where biophysical tipping points and thresholds have the potential to curb human progress and well-being. In order to facilitate this analysis, the conference was divided into four integrative themes that were intended to bring together perspectives from across the social and natural sciences, and humanities to better understand urban environmental issues in a more integrated, interdisciplinary and transdisciplinary way.

## WHAT YOU WILL FIND IN OUR CONFERENCE SYNTHESIS REPORT

Each session includes: a session abstract, key discussion points taken from comments, questions and answers that took place during the session, and a list of organizers and presenters.

Each individual presentation also provides synthesis material, which can include the presentation summary, key lessons learned, policy/practice implications of the research, and knowledge gaps and needs for future research and practice.

We hope that you find this book useful in finding new paths towards future research. Thank you to all the participants of the conference for their hard work and thought-provoking presentations.



# UGEC Synthesis Session #1 Interdisciplinary Understandings of Urbanization and GEC: Regional Patterns, Processes and Transitions

## SESSION ABSTRACT

This session aimed to synthesize our knowledge on the observed and projected trends in urbanization processes, their components and drivers (production and consumption, land use, form and function, population dynamics, technology, values, and policies), variations and extremes, and interactions globally and locally as well as critically reflect on our progress with respect to interdisciplinary research. It identified common drivers and feedbacks and identification of distinctive regional patterns and transitions within the context of global socioeconomic, geopolitical and environmental changes.

### *Guiding questions*

How do global and regional economic, financial, social and environmental changes taking place so far impact urbanization pathways in developed and developing countries and what are their consequences and scale?

What are the underlying processes of urbanization that impact other Earth System processes?

Can we identify regional differences in these processes and their consequences?

What lessons have we learned, for example, from the developed and developing countries to influence more positively the global urbanization processes and reduce their environmental impact?

Are these lessons coherent with local sustainable urbanization that is socially inclusive?

but also to some extent in Africa and is shaping urbanization and migration flows; across all regions these process of urbanization and changing dynamics are enmeshed in different ways and to different extents, not just in terms of domestic financial capital, mobilization and political processes, but global and regional as well.

In developing countries since the 1990s a shift has occurred in urbanization processes (particularly migration patterns) as a result of economic and financial drivers linked to globalization and associated economic liberalization policies; i.e., the pull factors of cities are stronger due to the greater economic opportunity vs. the previously more prominent push factors from rural areas.

Economic globalization enhances the role of place based competition, as capital investments which are often made in cities means growing competition between cities or metro regions, further driving inequality between places or regions

In the Southeast Asian region, as countries open up their economies there will be increased competition in urban spaces between developed and LDC countries, e.g., Singapore with Laos or Cambodia

In Indonesia, large cities are on the megacity trajectory, but often become paralyzed by private agency control; medium-sized cities have a late-comer advantage, as they are often more open to sustainability pathways and are more flexible; however, small cities are left out from development, as people often leave as overseas migrants and remittances are invested in medium-sized cities into property, etc.

Using the Indonesian city example (as similar elsewhere), diversified economies and industrialization have become uncontrollable,

## KEY MESSAGES

### ECONOMIC PROCESSES SHAPING URBANIZATION

Foreign Direct Investment (FDI) has played a role in many developing nations, not only in Latin America,

producing rapidly growing cities and conurbations, so fast-paced that responding is difficult.

In China, GDP pushes urbanization, however, there is no element of co-design or co-delivery to capture the co-benefits beyond the GDP link.

Economics is heavily linked to urbanization due to land, its value, but also fiscal policies and the governance structure; local authorities do not have revenue or the capacity to raise revenue, hence, land is the one way they can finance urbanization, to meet the GDP target.

Substantial money is being put into the funding of urbanization projects through national funding as well as local government's sale of land for road building, etc., however, there is no research addressing the impacts on local people or equality issues.

China and other transition economies present opportunities for rethinking market-based liberal democracies where individual freedoms cannot be constrained (e.g., failure of carbon taxes in Australia).

Most of sub-Saharan Africa's urbanization is related to global economic changes, wherein the heartbeat of the economy is influenced by global pricing, due to many nations' dependence on trade and primary products (i.e., when they do not perform well on the global market, rural areas suffer and people flock to urban areas - push factor - creating a situation of poverty transfer from rural to urban).

Economic theory that underpins capitalist societies is fundamentally flawed (known for decades, but persists nonetheless) and the role of the bank, particularly private banks from which the large majority of money comes from (rather than the Central bank) is not widely acknowledged, nor connected to and researched in the context of the environment and urban transformation.

### ***The role of the informal economy***

In Lagos, Nigeria (and elsewhere in Sub-Saharan Africa), the goal of urbanization at the national level - to create jobs and economic opportunity -

has negatively impacted the informal communities, increasing poverty and furthering inequality.

Informality in the Global South could be an opportunity to experiment with innovative systems, e.g., small scale systems that are distributed and networked, which are easier to manage over large scale systems.

## **LAND AS A DRIVING FACTOR AND CONSEQUENCE OF THE URBANIZATION PROCESS**

### ***Rural/urban tension***

In many countries undergoing an urban transition, fragmentation in terms of urbanity and rurality exists.

In India, the rural and urban is so divided (from the national to the district level to the sub-district level), and given that the future and cities themselves depend on rural activities or rural migration, they must be addressed together.

Agricultural land in developing countries is stressed and strained as the urban transition occurs; it is often unclear if such peri-urban lands 'belong' to the rural area or city, but in reality it is neither and will be challenging for projecting urban growth and classification, (e.g., there is no hybrid which is recognized by the UN).

### ***Land ownership and real estate markets***

Land itself and land ownership has huge implications for ecosystem services and the rural-urban relationship.

Fuel prices impact the urban land market which is dominated by effects of the mortgage/real estate market; i.e., how cheap it is to build is an important factor as well as the trade off effects of the real estate market, such as the desire to increase built-up land to provide shelter versus the use of land for public transportation.

In Port Vila, Vanuatu there is a tension between the years of colonialism with more customary lines of land tenure, e.g., planned government-owned area and customary-owned sections.



In Zambia and other Sub-Saharan countries, most of the land use in cities is informal, owned by traditional persons, which is linked to the development of slums and impacts the environment of these cities.

Sub-Saharan Africa is unique in that most of cities in the region do not have a clear rural-urban distinction (e.g., farming and off-farming movement in between cities) – urban farming there is very important and has implications for ecosystem services.

In Africa there is a trend of new cities deliberately being created for the same purpose of creating real estate (e.g., Port Harcourt in Lagos, and locations in Southern Africa and Kenya).

### **ACTORS AND GOVERNANCE: THE INFLUENCE OF SYSTEMS, AGENTS AND INSTITUTIONS ON THE URBAN SYSTEM**

Multiple actors and their interactions (e.g., foreign investors working with local developers and elite) substantially impact the direction of city growth.

Developers will continue to act if the academic community does not.

In many cities, governments are becoming weaker due to pressures of land and property, e.g., financial investors are giving direction to the cities and the cities, in turn, cater to their needs, without a focus necessarily on the most in need.

In Southeast Asia and other transitional economies, three actors can be identified: global corporations (economic and environmental power), an emerging middle class (purchasing power fueling economic growth with both positive and negative impacts) and the increasing role of local governments (through rising land and property markets).

In sub-Saharan Africa the rise of middle class and the upper classes are the focus of government in many cases, not for poor.

There has been a dramatic rise of cities on the international agenda for climate change over the last two decades that has resulted in new networked

forms of governance including transnational municipal networks and peer to peer learning.

South-South collaborations and the impact of these networks are undervalued.

In order to set up 'our' urban agenda an assessment of actors and their respective agendas must be made in order to see what room there is for the incorporation of different agenda.

### ***Power and political influence in the city***

In general, across regions there remains a lack of political and administrative will and spirit with respect to issues like urbanization and adaptation, and the establishment of related services.

Political processes, e.g., political actors, decisionmakers and land markets (public and private power relations) are integral to the urban planning process, but are often ignored by research.

In India, but in many other countries, there remains a huge disconnect between research and what is happening on the ground due to the influence of power structures and often corruption.

Engaging local communities from the beginning in the process is crucial, but also is an opportunity to decentralize sanitation and other services, etc. without inertia from large infrastructure networks

### ***Urban planning and decision making***

In China ecological planning has been incorporated into centralized planning, with cities able to move ahead or beyond national baseline requirements prescribed by national policy.

Velocity of change and the issue of 'time' is critical as planning instruments are not keeping pace with processes of urbanization, e.g., Chinese demand for copper is affecting cities within Chile where private wealth is accruing, but not necessarily increasing public wealth (services).

In many cases plans are prepared by planning consultants who do not know the local situation and cannot capture the emergent issues.

Planning is still inadequate with respect to integrating sectors and systems (ecosystems, built infrastructure).

Policy planners (development workers) see the cities as the economic hub – but the residents see it as a place that needs to be ‘livable’.

Instruments of urban planning (e.g., integrated urban planning) remain an issue to be explored across regions for the future urban agenda (complex science could make this science-policy communication difficult).

### **EQUITY, SOCIAL AND ENVIRONMENTAL JUSTICE FOR LIVABLE CITIES**

Despite an incomplete understanding of what we want for an urban future, there are shared guiding principles (e.g., justice, livelihoods, health) that provide a compass.

Vulnerable sectors of society, particularly in developing nations are neglected in the plans and at the mercy of the planners or the political leader, which highlights the issue of understanding actors and bridging the information gap.

Building capacity and engaging with the locals in the focal cities or communities of research should be a greater focus of academics.

Consultants are often brought in to create plans for cities, but there remains a big disconnect between these plans and on-the-ground realities, which highlights the need to be realistic about local capacities, particularly small cities (i.e., institutional realities vs. agents themselves).

In Lagos, plans for urbanization and economic policies that are geared toward job creation are, in fact, driving a further wedge between the few small, very wealthy groups and the poor majority, impacting most heavily the informal communities.

In China, migrant workers are moving to cities, comprising a workforce that is low-wage and without access and the cost of services is less, however, this leads to inequality and poses questions for the

economic structure in terms of the welfare state, services and access to those services.

### **Smart cities and technology**

The exportation of ‘best practices’ and experiences of the Global North to the Global South cannot simply be the solution.

There are various conceptualizations of cities currently that do not address fundamental issues, such as social equity and power issues.

Eco-city mega projects often include academics researching abroad in locations, but do we understand well enough the local contexts for these to be just?

### **Health**

The impacts of urbanization on health, a cross-cutting issue, particularly the disease burdened, is a link that is understudied, as many cities and the burden of non-communicable diseases (e.g., asthma due to air pollution) has a huge impact on economic development.

Health inequities are a result of increasing health risk through social and environmental changes (e.g., lifestyle changes and pollution) related to urbanization and lack of capacity to provide services that would improve health care for urban residents, particularly in developing countries

### **URBANIZATION PATTERNS, PACE AND SCALE (TELECONNECTIONS)**

Can we truly understand the drivers and processes of urbanization as a system of cities operating at the global scale?

Do we know enough about the process or processes in various regions to the extent that we can imagine future urban sustainability, and are we in a position to imagine potential future urban systems to the extent that we will know how it will interact with other systems, e.g., the food system and ecosystem services?

Underlying processes of urbanization are: land use/land cover change, conversion; consumption and

increased consumption; shifting sectoral patterns to secondary or tertiary employment; more concentrated flows of goods and services of energy and information to smaller more concentrated places on the Earth's surface and to increasingly more distant places; and, changing governance structures.

There are also countervailing processes to the forces toward urbanization mediated by land prices and property markets, political interventions, changes in environment, climate or broader GEC processes etc.; e.g., Tokyo (dramatic urban pull), Northern England (cities growing faster than the economic hub of London) and Switzerland's declining mountain populations (important for identity, culture and national defense), as the youth leave and older citizens need more care on a decreasing economic base.

Some cities in developing countries are becoming better connected with global cities (Bangalore with LA or San Francisco) because of economic factors or information technology, often bypassing hinterlands within the respective country.

It is the secondary/intermediate cities that have huge implications for various other socio-environmental processes.

Given how fast urbanization is occurring in many regions, the implications on lifestyles and changing lifestyles is important.

Economic development, urban planning and population density of the overall country, which influences city population density, all impact energy use of urbanization and urban structure; the long term (decadal) impact of fuel prices affects urban structure and form, i.e., current fuel prices in different regions will impact urban structure in 30 years.

Medium densities of 50-100 persons per hectare and inclusive transportation have local to global co-benefits whereas high densities suffer from the exclusion due to high land rents and also air pollution.

Small-scale city systems (plans and processes) occurring within the city can be expanded and endemic in urban processes, which is, in fact, what

urbanization is - individuals working in a collective fashion.

### **Technology choice**

Technology choice is an urban development pathway and is both driven by and impacts environmental, economic and social considerations (e.g., AC use); technology always has both positive and negative (unwanted) effects, which need further consideration.

Technology in the public sphere (via infrastructure) is an operational component of the urbanization process, e.g., engineers are designing the infrastructure based on societal norms and expectations, with legacies of changing cultural and regulative aspects.

## **ROLE OF SCIENCE, FURTHER NEEDS AND RECOMMENDATIONS FOR THE FUTURE URBAN AGENDA**

Most cities in the world still are not researched, i.e., there is no understanding of the differences or commonalities, which might exist among them.

More research is needed on the impacts of climate change and urbanization for rapidly growing countries in Asia.

Focus on the positive stories on adapting to future hazards and reducing vulnerabilities - over the last few years there seems to be a greater focus on urbanization driving risk, versus as an opportunity of reducing risk (DRR).

A focus on local application that includes finding out the problem and offering alternative options to enhance resilience, which requires both non-structural and structural measures, vs. structural measures only.

Although there are many challenges for the future, what we do know is the amount of urbanization in the future and we have tools that can help to analyze, visualize and conceptualize to understand what these futures might look like in terms of spatiality, density, water and energy flows.

Researchers need to admit their failures and learn from them.

### ***Knowledge production and transfer***

Good practices are not going to come from just the Global North, rather there is evidence of successful South-South and South-North transfers.

International knowledge transfers must be better researched (Europe to China or other way around) to understand the local and regional differences in how the knowledge manifests.

Co-production of knowledge - many actors (end-users) are not involved in the research design, especially those without voice (e.g., poor and marginalized groups), who need a lot of attention and time to establish trust.

There remains a disconnect between what people need or want, or are interested in or care about versus what the academic community is producing - this might require a rethinking of the kind of research done if it aimed at participatory processes.

Knowledge production has a spatiality, cities are centers of innovation and higher education where the accumulation of knowledge is correlated to economic processes in cities.

Urban simulations need to be made more accessible to people in general.

### ***A different science agenda***

Reframing the interventions from a control and management perspective towards an agenda that is about being flexible and building self-reliance.

We do not need to understand the whole system before acting, but we can detect the leads at the early stage and help influence the process where possible; i.e., a change of mindset that includes an obsession with data.

Developing capacities and abilities to deal with uncertainty is important for countries within, for example, Latin America and Africa.

Before moving towards totally new frameworks, it is worth revisiting those which we have and have not

been successful with (e.g., ecological economics and its pricing for ecosystem services or externalities).

Science is needed that follows the continuum (fluidity and movement beyond boundaries); the humanities are far better equipped to deal with this and theory development.

A science is needed that is decisively political and can engage with the political dimension.

Opening up of science boundaries that asks 'what is the type of science that we need,' in order to find the answers, e.g., reconsidering positivist science towards more critical social theory that allows a reimagining of our collective future development and reframing of the way policies are conceptualized.

GEC frames research on the social-economic and environmental, but other kinds of questions addressed in the social sciences are ignored such as structure, agency and institutions. Very little discussion in the last ten years has addressed how States have responded on raising taxation or incentivizing different technology or land use changes. If in the future, this community critically looks at austerity, economic change and the environment, then it would be worth widening up the conversation to other scholars who more closely look at financial flows to address the connection with urbanization processes. '

# UGEC Synthesis Session #2 Urban governance, technology and innovation in an era of environmental change

## SESSION ABSTRACT

This session took a critical look at our current notion of technology in cities as well as our urban governance structures, and offered insight to ways forward in research and thinking about how we can accelerate sustainable urban transitions. The aim was to synthesize our knowledge of key urban governance in the 21<sup>st</sup> century, analyze what arrangements are most effective and how we can better coordinate multiple stakeholders in participatory urban governance processes while addressing key spatial and temporal challenges associated with urbanization and global environmental change. In parallel, the session considered what research reveals about technology and innovation in urban areas; smart, eco and zero-carbon city strategies; and evaluation across developed nations, and in particular developing regions. It also explored some of the associated challenges that concern social inclusion or exclusion, merging vision (often influenced by exogenous factors) with reality (local political and socio-economic contexts) and what effects these have at the meso-scale or global scale.

## KEY MESSAGES

### ***What are the key messages that we've learned about urban governance research and practice (synergies or disconnects between the two)?***

Urban governance is the most polycentric of all governance with multiple institutional scales. Urban governance research has a better chance to be successful in the policy context.

There is a disconnect in terms of the two streams of research. On the one hand, there is research on the understanding of the context or conditions that enable urban governance, and on the other, research

that focuses on the development of urban policy or decision making.

Urban governance research and practice is a static practice, but cities undergo dynamic change. Whether it is urbanization, climate change, technological evolution or policy, these types of processes are disconnected (some of them are cyclical, e.g., environmental extremes; policy processes).

Urban governance frameworks do not start from the point of change. Traditionally or historically rates of change have not been dealt with, which means both environmental change and urban change issues are often not well addressed.

Regional level governance structures are rapidly emerging, which have implications for urban development of both existing urban areas and the creation of new multifunctional urban areas. In West Africa, for example, regional level transportation infrastructure is being discussed; in East Africa, devolved oil pipe and transportation infrastructure from South Sudan/Uganda to the Kenyan coast for refinement and use has implications for the region.

Good practices and knowledge transfer is important for successful governance. For the policy agenda to reflect a changing climate or available information, the identification of how current practices can be slightly adjusted in different regions is critical, e.g., the NYC Hurricane Sandy experience.

Corruption and invisible power relationships exist in the governance of urban systems. This speaks beyond a disconnect to the fundamental power structures of money and the current system of production.

Self-learning works better in developing countries vs. guided learning. Participatory learning and citizen

involvement is more effective than top-down guided interventions.

Politics respond to interests that are often not backed by science. Professions including engineering, health, or urban planning are more influential in this regard.

Politicians do not have the same long-term concerns as researchers, but scientists often do not understand policy. A better understanding of each other's assumptions, needs and wants are necessary for co-production.

Caution in co-production. This concerns how and when co-production can and should be done, as there are different conceptualizations.

Local communities are important, as they are the user of spaces. These communities can provide strong pushback to global processes, leading to change.

Intermediary organizations (NGOs) and the role of consultants are important for bridging science-policy gaps. In China, as in many other countries, the government and citizens are very disconnected, with NGOs helping to bridge this gap.

A large disconnect exists between citizens and researchers. There is not enough understanding of the commonalities or lessons learned involving the common people in policymaking in different cities and between the Global North and Global South.

Putting mitigation on the policy agenda remains a challenge. Convincing local officials and politicians from developing countries without high emissions (when compared globally) to focus on mitigation efforts, when in effect, it halts development as it is currently understood, continues to be very challenging.

There is increasing convergence of mitigation and adaptation in developing countries.

These motivations are economic, as there are often greater resources available through mitigation vs. adaptation. Some cities are looking at opportunities beyond GHG inventories towards how local people

can gain employment and income around mitigation (green economy).

The mainstreaming of response in policy and resulting implementation are dependent upon the legitimacy of design. There is evidence of places where local authorities are mainstreaming some form of environmental or climate change responsiveness, but the implementation requires rethinking city structure, who lives where, and what to do about it. This brings in questions of legitimacy, i.e., as the policies are often developed in multiple ways (authoritarian, bottom-up, co-produced or quasi-political).

***Are there indicators that global environmental change is incorporated as an important element of urban governance beyond current responses to climate change?***

Response to GEC challenges in cities and their interactions remain unclear. These include measures addressing biodiversity, regional/city areas around land change, and competition between food production and forestry with urbanization.

Indicators could include green businesses and subsidies/incentives for green business; green technology; urban expansion vs. inner city development (e.g., lower footprint), involvement or engagement of civil society groups being engaged, e.g., CBOs or NGOs at different levels.

Indicators have not been incorporated in mainstream business. An exception to this is the response to disaster circumstances. However, if and when they are incorporated in the monitoring, governance or decisionmaking mechanisms, how will they play out through the political and institutional processes (e.g., through top-down and enforced, or dialogic processes with co-produced outcomes)?

Indicators are present but there are winners and losers. Climate change creates winners and losers; e.g., frameworks like smart cities are often used with neo-liberal policies that are greened, ambiguous and not always positive.

Water cycles are an element of GEC not uncommon to governance. Water and management, access and quality are important policy triggers in many countries.

***Are smart, eco, and zero carbon cities defined in the same way in developed and developing countries and what are their potential contributions in terms of technology/innovation for urban sustainability particularly in light of anticipated global environmental change?***

Eco-city concepts need to be unpacked. The definition of an eco-city is not straightforward, as it sometimes includes notions of urban greening or incorporation of nature, but whether it includes low-income people or addresses energy use or mitigation is unclear.

Innovation first. The intention of smart cities was to begin with a discussion of the problem needing to be solved, where technology was then used as a tool to support the innovation that could solve the problem. Mayors and other decisionmakers are often fixated on the eco-city as an end rather than a means.

Ensure that the technology employed addresses the problem. A challenge is that researchers do not always know the problem when it comes to making cities sustainable. Policymakers require a solid base for decision making and researchers need to think about easy and robust systems in developing countries where the financial means do not exist.

Changing dialogue. The dialogue surrounding eco-cities, smart cities or low carbon cities has replaced the more holistic urban sustainability approach, which is about equity, justice, etc. - where eco-cities are not.

De-emphasis on adaptation. International finance and international agenda setting of eco-cities has de-emphasized adaptation, where in some contexts is important.

The green economic agenda is the macroeconomic equivalent of the green city/eco-city, etc. In the same way one may be critical of the green economic

agenda vis a vis sustainable development, the same argument or concerns exist at the level of urban agendas which have shifted.

There is money in smart cities. Politicians like smart cities, and as a result gain support from academics because of the money smart cities bring in, undermining other and potentially better approaches.

Grassroots examples exist in some cases and may be worth exploring further. U.S. Emerald Cities Collaborative is an example of an organization that was founded to develop green jobs or blue-collar jobs, reduction of waste and empowerment of communities.

***Have these initiatives unintended consequences with respect to social equality, regional balances or more holistic interpretations of urban sustainability?***

International knowledge occurs often without an understanding of or engagement with the local context. In China, Bus Rapid Transit development has lacked strong government regulations where locals were displaced and has led to gentrification, however, this issue is ignored due to higher importance placed on land values.

Technology can be a powerful tool for empowerment. Certain technology can be used at the local level to give bargaining, decision making power, etc., especially for the poor or disadvantaged (e.g., simple tools, such as the use of GPS technologies for changing forest settlements in India.)

Mapping and equity issues. Risk mapping that engages through social media, online platforms and tools must have a clear purpose. Is it serving the community? How can urbanization and change be relevant to the community at large?

Mapping exposes deeper issues. Example of India urban slum mapping proved to have challenges and push back related to the deeper questions of 'what is a slum' or informal settlement definitions.

Conceptualizing livable urban futures. The distinction between a goal and means is useful; for example,

the Global Carbon Project has defined a set of goals (livable, etc.) and lower carbon is a means to achieve those goals.

Incremental vs. fundamental change. There is a debate about what is needed for change and how this is approached. However, there may not be a clear dichotomy between the two, e.g., scientists can become very powerful when findings are connected to policy or law-making (also raising democratic issues) particularly when developers and financiers do business differently under a system of law that changes due to scientific findings.

***How can we best move forward? What are the needs for research and/or design to make urbanization/cities 'smarter' but also 'inclusive' and 'more sustainable'?***

Role of science and the intellectual in society. Scholars are defacto involved in politics and governance via expert panels or consultancy work, etc. Scientific work is non-neutral and normative; therefore, transparency of the intentionality of the work, vocabulary used and ethics would help bridge the separation of 'us' vs. the rest of society.

Avoiding biased science and more reflexivity. There is a continued concern about biased science and about doing research to further political interests. Work with public-private partnerships and NGOs, which all have their agendas, can result in 'capture' as consultancy and scholarship is not often compatible. More reflexivity with respect to participation, looking at how academics view scholarship and independence in these processes will not solve the issue, but can result in more transparency.

Finding the niches to be effective. This community is not about being organizers or politicians, but has a different role to be explored carefully and well.

Making explicit the epistemological underpinning of research. Governance can be used as an analytical tool (to observe and understand) or it can be used to push a normative agenda. A future challenge is to be more explicit about pushing an agenda if that is the case.

Underlying epistemologies exist not just between disciplines but also within.

Research of urban governance. It is important for future research to include how urban governance works and how urban governance structures move towards sustainability.

Power as a topic for research. Private companies have the financial influence. Microeconomics and the use of limited resources need to be researched.

Methods and approaches to co-design. This would explore how to bring different interests into the discussion.

Creating a forum and space for different stakeholders. Those with interest must be there from the beginning to engage in shared or iterative learning; knowledge can also be socially transformative.

Continue to push in the small-scale efforts. They have value

Getting the science 'right' will not change policy. This is not a correct mental model, but needed is a better understanding of how learning and change can occur to bridge the science-policy disconnect.

Identify where there is real learning and change in behavior (individual behavior or collective).

The role of governance and technology or smart cities in urban transitions and increasing vulnerability or resilience. Governance and technology is more often used to maintain the status quo, e.g., build better dykes; the NYC Hurricane Sandy response was to rebuild and did not question the fundamental system of economics and private property.

Mapping. Knowledge is power and can be used as a mobilization platform, e.g., Google Earth, for people to map themselves or aiding in assessment and associated payment of ecosystem services.

Question of mapping and who is mapping. Who is 'we'? There should be capacity building of the local people (e.g., in the effort to map Africa) who can use



the information, help create the information, etc.

Advances in the global observation community. This community is developing mapping tools that are high resolution (10m) to show built-up area and also elevation change, etc., there must be a community that will push this forward into policymaking arenas.

Using tools including social media that catches attention and interest. Use of maps offering color and dimension aids decisionmakers. Urban researchers are behind in using social media (in general, having more frequent interactions and dialogue with policymakers on our work would help the disconnect).

The role of the consultant and knowledge brokers. These are key stakeholders with potential to inform the policymakers that make decisions; identifying and creating more of these organizations would be useful.

Future students. This is the way forward and offers great potential for societal change.

Aligning the time scale, interest and agendas of different actors. Tools for engagement and more connected research and practice include: Being realistic about the expectations researchers have from decisionmakers and vice versa; empathy in terms of the roles and challenges of different actors and institutions; knowing the drivers of engagement for each stakeholder; and, asking better questions from the 'other's' perspective.

Develop a set of ten principles to work from that would help bridge the science-policy gap.

Understanding transformational governance. How can this be experimented with and what are the opportunities? Where is the experimentation occurring and where can we rapidly translate those understandings or practices to other contexts? For example, the UNU worked with ICLEI to develop planning for biodiversity (guidelines).

Academic system and policies. Is our system able to fit this diversity of more or less radical approaches to really discuss transformation and lay open the normative claims in writing?

Trust building for transformation. This requires time and a deep knowledge and commitment of place (not just with the elected officials, but middle managers), in order to be committed to the goal and the normative values behind it, and provide knowledge in the right kinds of contexts.

Moving back towards or reclaiming 'radicalism' or critical thinking and theory. This includes more reflexivity surrounding where certain modes of governance can and cannot bring us.

Regional level governance and what is emerging. Emerging governments at the regional level are creating, designing, envisaging or planning for urban development, which is most likely building upon existing converging urban systems, to create corridors or regions that are thought to be strategically important with implications for economic development and social transformation.

Reconstruction approaches need to be fundamentally changed within disaster management. Despite studies that show communities need to move inland, practitioners must deal with the people who want to stay.

Re-conceptualizing appropriate building design standards and understanding they may change over time.

Reconciling the 'them' vs. 'us'. What researchers might be defining as resilient or sustainable may not align with what the communities want or believe. What does it mean, particularly for governance, democracy and communities to define their futures?

Finding the triggers to initiate change. Universal concerns such as the well-being of future generations or concrete examples, e.g., of how expenditures (prices of milk, bread, etc.) have increased and the reasons could result in individual change and then collective change.

Burning issues. Extreme events are easy-to-understand triggers, but numbers need to be shared with decisionmakers, going beyond philosophical

or qualitatives, the negative implications need to be communicated for the politicians to take notice.

The urban rich. What can we learn from the urban rich, in addition to the urban poor, whom have been studied?

Research funding to bridge the science-policy disconnect. Looking toward greater opportunities for social science research to receive funding supporting knowledge transfers (more often granted to engineers), i.e., transferring lessons learned to the local government in order to co-develop for solutions.

Climate change funding streams. Many communities and governments are tapping into new funding streams because the labeling of 'climate change' can still maintain the status quo of ordinary development work, which otherwise wouldn't be funded. To what extent the work is adapted to the changing parameters necessitated by adaption to future climate change scenarios is currently negligible to zero.

The influence of research funding institutions and the implications. This raises fundamental questions about agenda setting, e.g., 'sustainable development' doesn't exist as a term in many funding sources, but 'smart' and 'innovation' do; adaptation actions have often responded to extreme events, where 'climate change' is tagged on to other issues.

Risk perception sharing between cities. To do so before an event actually occurs, rather than only post-response.

The speed of response. The rate at which policy and governance structures are being developed is outpacing well-thought out response strategies requiring research into how these are emerging and developing, and the implications for this research community.

The freedom of time is not global. There is embodied energy in research and the tools created (e.g., GIS mapping or research generally) including physical time, people, effort, etc. There are imbalances in the applications of those tools.

# Special Session Livable Urban Futures: Transitioning 'Urban' into Future Earth

## SESSION ABSTRACT

In February 2014, London, UK, the UGEC Project organized a Scoping Meeting with the goal to share and discuss ideas for shaping and moving forward a new urban initiative (or initiatives) that would fit within the Future Earth framework. The meeting included participants representing a variety of disciplines, communities of practice, regions and perspectives with diverse experiential knowledge and research expertise. In June 2014, the UGEC International Project Office and Stockholm Resilience Centre were awarded funds from Future Earth and the National Science Foundation to further advance the urban research agenda within the Future Earth framework. Building upon the February 2014 meeting and as part of the awarded proposal, a series of workshops took place throughout 2014 and 2015 including the development of the Urban Transition Team (UTT). This group is tasked with overseeing the process, providing the overall intellectual direction and establishing the framework for the long-term goal of creating a Future Earth urban initiative. The aim of this session was to share the progress of this important effort and to obtain input regarding the key elements of this initiative's design including: a) Research gaps and needs for future urban research; b) Key urban research and policy relevant questions to be addressed moving forward; c) Potential key partners to advance a new urban international research agenda; d) Other critical components that must be considered in the design phase; and, e) How to best incorporate local and regional science and policy communities.

## ORGANIZERS

David Simon, Royal Holloway, University of London, UK & Mistra Urban Futures, Sweden

Patricia Romero-Lankao, National Center for Atmospheric Research, Boulder, CO, USA

Thomas Elmqvist, Stockholm Resilience Centre, Stockholm, Sweden

## KEY DISCUSSION POINTS

### *Funding*

Are we truly moving beyond the 'funding council' model for giving out money for research to a process of supporting the transition to sustainability (i.e., a very different model than the funding model)?

Funding is not conducive to co-production as it is not something one can predict. How do we get around the fact that in doing sustainability research (co-design/production), the outcomes and timeframes are uncertain, yet, funders want specificity of these areas?

Arts funding may be an unexplored opportunity.

A good funding mechanism would be akin to the competitions designed to help cities and mayors, e.g., slim-city knowledge cards - one side is picture; on the other, best practices, a figure or graphic. The research community needs new formats and different deliverables.

Future Earth could provide a platform to identify and coordinate funding mechanisms between cities and countries to further develop international cooperation and could be a lens to enhance funding from government agencies and international organizations.

### *Research/Flagship Activities*

How do we identify what is contributing to sustainability at the urban scale? Do we have this knowledge? How do we define processes that enable researchers to engage in actual helping on-the-ground sustainability?

Competitions could get people thinking differently and to pay attention to Future Earth. For example: Map 2050 – visuals of ‘wow-trends’ that we need to address with one map.

Multi-city comparisons. What kinds of urban can we compare (typologies)? In what contexts is knowledge comparable?

Systematic comparative research - Distilling out underlying principles or guidelines, not best practices (top-down) but good practices, recognizing context specificity but identifying what works, what didn't and why, and try to adapt this knowledge. This can only be done if one looks at multiple examples of the phenomenon or process.

Meta-analysis/knowledge approaches with identifying pathways or prototypes for selecting cases for better study of these bigger issues. Not only asking what the findings were but also what questions were asked, what assumptions were made, and what criteria were used to compare cities.

Mapping out barriers or challenges to engagement. The issue is that others will solve the problems - so how can ‘they’ engage ‘us’? UGEC or Future Earth could be the process by which we are engaged with what is happening. How do we overcome the internal academic cultures that make it difficult to talk with other disciplines as well as other stakeholders?

Linking cities at the global level - Future Earth could provide the service of linking cities at the global level. In the US, for example, local sustainability plans (with the exception of CO<sub>2</sub>) tend to fail to link to other global scale processes.

Disaster Risk Reduction (DRR) as an entry point - DRR work gets communities involved, which is taking place in Africa by the ICSU Regional Office (e.g., 2015 Global Assessment Report on Disaster Risk Reduction- these activities are well-connected to people who make decisions).

Innovative data. Social media or other technologies, cellphones, big data and mobilizing this data could produce a portal for collection and dissemination

as well as offer a way to educate and empower communities.

Intervention and innovation. Frame these flagship activities in a way that does not focus on observation and trends, but more proactively about the interventions, innovations (technological and social innovation).

Broadening the conversation. The stakeholders we generally talk about are never here. Why is this and how can we broaden the conversations? Raise funds to bring in stakeholders.

Regional urban challenges - Organize a targeted, well-facilitated number of workshops capitalizing on the distributed Future Earth Secretariat. Questions to ask - What are the practice challenges at the urban level?

Design for the high-income world. Let the Global South come up with solutions for developed world problems (suitable for SDGs). The more affluent usually find solutions for bottom of the pyramid - what if this were reversed?

Visioning and design. The research community must be better at marketing or branding and could be a guiding force for future generations (e.g., urban planning innovations such as Frank Lloyd Wright design, etc.)

Overcoming path dependency. The challenge is to link to the communities, but to do it in a new way based on our understanding of how sustainability can be strengthened and reinforced. Sustainability will look different in different parts of the world and strategic thinking must be taken to consider the kinds of challenges and opportunities from various regions (what's feasible?). Thinking through the different scales of networks requires priority setting to consider where to start drawing conclusions, followed by the application to other settings.

### ***Engagement and Stakeholders***

What do we mean by ‘engage’ and what level of the hierarchy are we concerned about?

How do we engage cities and other stakeholders with often shortsighted objectives and maintain their engagement through often long processes?

How do we identify ourselves as enablers of the process towards sustainability? How can the academic community play an enabling role to enhance sustainability by building upon and engage with other communities, public/private sectors and NGOs that are doing work in the local communities (co-production)?

Economics. Many developing countries will contribute to much GDP and urbanization occurs quickly in non-OECD countries, but we don't seem to have tools and mechanisms to keep up with that speed. Co-production takes much time, but cities are developing so fast (big gap); engaging with economics could help (e.g., World Economic Forum).

Disenfranchised populations. How do we bring in the voices of Asia, Africa and Latin America that do not have resources to attend conferences and other venues? Include volunteer groups, e.g., Peace Corps, etc.

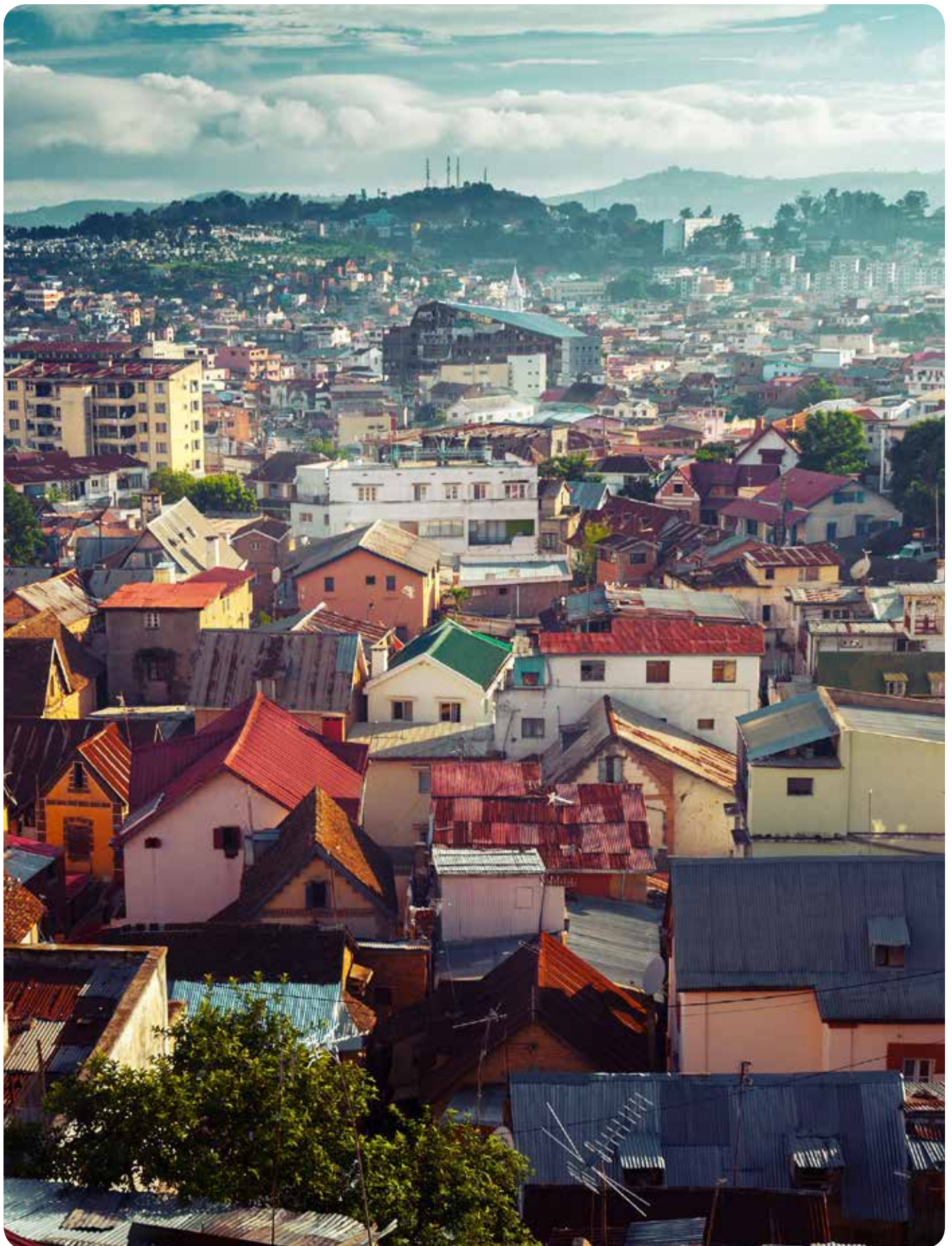
Ensuring that all stakeholders affected by urban projects and decisions are included in the process; e.g., rural people are often very much affected by urban decisions.

Politics. Better understanding of the interplay of international negotiations and cities (politics is not necessarily rational or about long-term challenges, often issues are narrowly focused).

Education and educators, including young people and the general public, must rethink how urban issues are being taught in universities (e.g., architecture).

National governments must work directly with local governments in cities and could provide a platform to get movement quickly. This is an opportunity to link up with communities closer to where urban development decisions are made.

Network of stakeholders. Future Earth wants to develop more in terms of a networking structure, i.e., we need to ensure that sustainability locally does not erode it elsewhere. We should work with stakeholders in a networked fashion that has a vast reach.



# Theme 1 Urbanization Patterns & Processes

Cities have undergone unprecedented social, cultural, economic, environmental and institutional transformations as their sizes, structures and functions change over time. We now have a better understanding of the teleconnected nature of urbanization and globalization processes, which blur the distinction between urban and hinterland areas, i.e., through flows of people, financial and natural resources, and land use change processes that drive and respond to urbanization. In this sense, cities and their regions are connected to and dependent on other regions, even in other continents as well as being connected across different spatial and temporal scales. Furthermore, global environmental changes affect these local and regional human processes with implications for well-being, and shape the construction, form and function of the built environment.

Of the four themes which guide the UGEC project's science and implementation, the ways in which urbanization affects global environmental change processes and conversely, the pathways through which global environmental change affects urbanization have been the most extensively researched over the last decade, contributing knowledge from numerous case studies across many world regions. The conference sessions that fall under Theme 1 are representative of this, as they explored these bi-directional interactions from a range of topic areas and disciplinary perspectives, not to exclude contributions of theoretical insights that seek to better understand urban areas as a dynamic system of globally networked socio-ecological processes.

The session provided insight to what we have learned about the driving forces responsible for transformation patterns and processes in cities, i.e., how and why urbanization today differs from urban processes in the past (i.e., as an outcome of decisions, actors and institutions), and the pathways through which specific types of global environmental change affect local and regional human processes and well-being, e.g., economic activities, livelihoods, urban life, migration patterns, social well-being and human health.





# Session 40 Urban land teleconnections: From concept to implementation

## SESSION ABSTRACT

Land change and urbanization are significant components of global environmental change. The emerging conceptual framework of 'urban land teleconnections' (ULT) sheds further light on their connections by examining the underlying processes of urbanization and land changes. ULT is a concept that describes the distal flows and connections of people, economic goods and services and land use change processes that drive and respond to urbanization (Seto et al., 2012). The concept hypothesizes changing spatio-temporal relationships of urban actions and decision making and global impacts.

Therefore, the conceptual framework envisions transformative changes in i) the traditional system of land classification that is based on discrete categories and reinforces the false idea of a rural-urban dichotomy; ii) the spatial quantification of land change that ignores the connections between distant places, especially between urban functions and rural land uses; and, iii) the implicit assumptions that emphasize path dependency and sequential land changes in land transitions.

For these transformative changes to occur, there is a need for both theoretical and analytical advances. Empirical discussion is necessary in terms of: Does it capture the global networking and impact of cities in a new and understandable way? Does it help to explain driver-pressure-impact chains around the globe? Does it help to better foresee consequences of global urbanization across the globe? The direct and indirect land use changes are critical in the ULT framework whereby land use change at a specific location to meet a co-located demand (direct land use change) leads to a cascade of induced land use changes elsewhere (indirect land use change).

The objective of this session was twofold: to provide a state of the knowledge on how and where urbanization is driving land change, and to assess theoretical and analytical approaches that could operationalize the concept of ULT.

*Keywords: indirect impacts, consumption, urban metabolism, migration, material flow trade*

## KEY DISCUSSION POINTS

Urban teleconnections can help better define 'urban' and 'urban sustainability', which helps set better sustainability goals and enhances the understanding of urban complexity to policymakers.

The teleconnections framework can be expanded and further developed by carrying out systematic reviews of literature from seemingly disparate fields such as political ecology, industrial ecology, industrial engineering (through material flows, production and consumption, nodes, life cycle analysis, urban metabolism) and economic geography.

Increases in information and knowledge can alter existing networks of connections and create new ones presumably leading to more complex networked connections, e.g., the introduction of the internet; knowledge gained by younger generations and introduced to older generations.

Pushback on the urban teleconnections framework has mainly focused on whether or not it is something new or simply a recycled concept.

The genesis of the urban teleconnections framework resulted from a workshop by the Global Land Project and the Urbanization and Global Environment Change Project to rethink the relationship between land change and urbanization, to re-conceptualize land use and to include issues of justice in an overall land use framework.

Further knowledge gaps and needs include:

How can we use urban teleconnections to achieve the Sustainable Development Goals?

What is the primary goal of urban teleconnections research? What do we want this framework to accomplish? Do teleconnections have any potential policy impacts? Who is the client for the framework and information generated through the implementation of this framework?

What are the general patterns of teleconnections across space and how do these patterns change over time?

How can urban teleconnections include an explicitly human component, i.e., how can we incorporate calorie tracking, nutrition, happiness and public health into an urban teleconnections framework? How do we quantify social aspects of urban teleconnections?

## ORGANIZERS

Michail Fragkias, Boise State University, Boise, ID, USA

Burak Güneralp, Texas A&M University, College Station, TX, USA

Dagmar Haase, HU Berlin and UFZ Leipzig, Berlin, Leipzig, Germany

## PRESENTATIONS

**Alisson Barbieri**, Gilvan Guedes, & Reinaldo Santos, Universidade Federal De Minas Gerais, Belo Horizonte, Brazil

*Population mobility, livelihoods and urbanization in the Brazilian Amazon*

## SUMMARY

The nexus between population mobility (internal, international, circulation) livelihoods diversification and growing urbanization in the Amazon has been affected by a plethora of factors at regional and global scales. These include the expansion of internationally

market-oriented activities, infrastructure building and increasing migration networks - combined with traditional migration selectivity factors (e.g., age, income and education). It is not sufficient to discuss 'urbanization' in the Amazon without an assessment of rural changes, and how these are articulated through flows of people and economic activities at regional and global scales.

## KEY LESSONS LEARNED

The changing nature of population mobility into and within the Brazilian Amazon has shaped a specific type of urbanization, with its impacts on regional development and on the environment. In order to understand 'urbanization' in the Amazon, it is necessary to assess its interactions with rural changes, particularly in terms of flows of people and of economic activities.

The intense urbanization process in recent decades has produced a myriad of urban forms beyond cities and towns that have required new definitions beyond the traditional categories of city/country and urban/rural.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Policies specifically designed to foster development, environmental protection and the welfare of the people living in the Amazon are often ignored. In particular, the importance of developing policies that better protect what is left of the rich tropical forests while simultaneously improving human welfare in areas of growing urbanization have been neglected.

Various policies should be considered to alleviate poverty and achieve more sustainable development; but while remedial policies, such as better extension of welfare programs to the Amazon could alleviate impoverishment in the short run, long run policies are needed.

Policies are needed to improve livelihoods, which are articulated with better planning of investments in 'social overhead' in frontier areas, particularly in the construction of roads.

While permissive migration policies have been effective for the geopolitical purposes of occupying the Brazilian Amazon and inducing inflows of migrants (particularly from southerners) as well as relieving land pressures and conflicts, recent transformations of the frontier with the expansion of agribusiness and infrastructure development (with population redistribution engendering a high pressure on existing forests and urban infrastructure) have demanded a much more active public policy role, particularly in planning the road network expansion and minimizing its negative effects on urbanization and deforestation.

### KNOWLEDGE GAPS AND NEEDS

It is necessary to develop new approaches and ways of inquiry and understanding of the diverse socio-spatial forms and processes that are being created throughout the Amazon beyond the city-country dichotomy. The collection of empirical data from multiple study sites using a pluralistic, mixed-method approach may provide the necessary evidences to examine urbanization trajectories in the Amazon and their impacts on global environmental changes.

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Stephen Leisz, Colorado State University, Fort Collins, CO, USA

*Road Development, rural and urban land cover/use changes and urban expansion*

### SUMMARY

This study investigates the role that road expansion and development in Southeast Asia is playing on rural-urban development interactions, urban expansion, and on land use and land cover changes. In the late 1980s and early 1990s, the analysis of road expansion in Amazonia indicated that roads served as conduits for settlers into the region and the resulting settler-forest interaction led to deforestation. Following this, many have assumed that roads act as, or, at least operate to facilitate drivers of deforestation in remote or frontier regions. Recently in Southeast Asia this narrative is being challenged, e.g., these changes as they are being evidenced along the east-west economic corridor from Da Nang, Vietnam to Khon Kaen, Thailand.

### POLICY/PRACTICE IMPLICATIONS OF RESEARCH

One potential influence is the rethinking of the role that roads have on land use/land cover in the region. The resulting impact from connecting the rural to the urban markets are changes in the choices made by the rural population with regard to what they produce (Central Vietnam) or how they allocate labor (Northeast Thailand). The implication in both cases is that less labor is available for previously emphasized agricultural production (e.g., rice cultivation in both places) and an increase in tree-cover. If initial findings play out, this will call for a rethinking of policy and strategies with regard to road development in rural areas, among other implications.

### KNOWLEDGE GAPS AND NEEDS

Knowledge gaps have to do with the exact nature of the tree cover that is appearing on the landscape. Is this tree cover analogous to the 'natural' tree cover previously found in the area, or are these tree crops? If the latter, how do these tree crops interact with the ecosystem services of the area and what downstream effects are there because of the increase in these tree crops?

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Burak Güneralp, Texas A&M University, College Station, TX, USA

Karen C. Seto, Yale University, New Haven, CT, USA

*Four manifestations of urban land teleconnections*

### SUMMARY

Evidence of Urban Land Teleconnections (ULT) is presented, drawing from four manifestations of urbanization. Along the lines of the ULT framework, the importance of process-based conceptualizations of the interaction of urban places with one other and rural places along a continuum of land systems is highlighted, followed by discussion of the knowledge gaps on how and where urbanization is driving land change and potential approaches to address these gaps.

## KEY LESSONS LEARNED

Urban land teleconnections (ULT) is a conceptual framework to link urbanization dynamics to land changes. Process-based conceptualizations of urbanization and land change highlight the diversity of ULT. Novel methods such as spatially explicit life-cycle analysis can be used to identify ULT. Conceptual frameworks on phenomena that transcend boundaries of specific locations can improve the knowledge base on ULT.

## KNOWLEDGE GAPS AND NEEDS

In order for the ULT framework to be fully implemented, more research is required to identify appropriate methodological approaches. Spatially explicit life-cycle assessment (LCA) and commodity chains analysis are two examples of analytical methods that can capture the linkages between processes by tracking the flows and accumulations of materials and information. There are several other methodological approaches such as material flow analysis (MFA) and consequential LCA that can be employed to study the ULT.

It is important to acknowledge other conceptual frameworks that approach the linkages among multiple places from different perspectives than that of the ULT. As an example, 'trans-locality', concerned with socio-spatial dynamics, such as processes of identity formation that transcend

boundaries of specific locations, has parallels to the ULT. The opportunities for cross-fertilization between the two concepts deserve to be explored. Such cross-fertilization would prove the most useful for concurrently examining social and physical processes in migrations (rural-urban as well as lifestyle migration) or for more in-depth study of the formation of attitudes toward environmental protection and biodiversity conservation. However, it could also be employed to analyze the social and cultural dynamics underpinning the flow of commodities and raw materials that link multiple places.

Moving closer to sustainability requires achieving the right balance in studying the social, economic, and biophysical processes governing the interactions between urbanization and land change.



# Session 52 Urban metabolism: The environmental impact of cities

## SESSION ABSTRACT

It is all too often reaffirmed that cities are major consumers of natural resources, leading to significant direct and indirect impacts on the environment. An important avenue to understand these impacts is through the quantification of the flows of material and energy that enter and exit the city as well as their transformation within the city itself. Such urban metabolism studies are increasingly used to understand the environmental impact of cities. In a nutshell, urban metabolism studies conceptualize cities as 'living' organisms that consume energy, materials, food and other inputs, and in the process 'store' them, grow and produce goods/services (in the broadest sense), pollution and waste. Unraveling such metabolic patterns is important not only for understanding the impact of cities on resource use and the environment, but also for explaining other phenomena such as rural-urban linkages and land teleconnections. Furthermore, urban metabolism studies can provide rich insights that assist planning for sustainable and resilient cities in the face of global environmental change.

The session discussed how the concept of urban metabolism can be used to shed light on the resource consumption patterns and environmental impact of cities. After a brief presentation that outlined the main concept associated with urban metabolism, case studies from around the world demonstrated how urban metabolism studies elucidate the links between urban resource consumption and environmental impact.

*Keywords: urbanization, land transformation, agriculture land change, agriculture production, impact mechanism*

## ORGANIZERS

Alexandros Gaspertos, University of Tokyo, Tokyo, Japan

Peter Marcotullio, Hunter College – City University of New York, New York, NY, USA

## PRESENTATIONS

Stephanie Pincetl, University of California, Los Angeles, Los Angeles, CA, USA

*Positioning urban metabolism to enable future transitions: an integrated infrastructure, economic and behavioral assessment of Los Angeles*

## SUMMARY

Urban metabolism studies have been conducted for dozens of cities across the world. Most of them have been conducted using aggregated or simulated data, as data at finer spatial scales are often unavailable and rarely fully integrated with socio-demographic information, historical data, land use and policy decisions. This limits the ability to determine drivers of current metabolisms and how hard and soft infrastructure combine to create path dependencies that make transitions difficult. Some preliminary results from a study of Los Angeles using integrated data rich methods are presented. This approach sheds light on drivers of current patterns and reveals path dependencies that need to be addressed to transition to a more sustainable metabolism.

## KEY LESSONS LEARNED

Cities are the result of historical evolution and their current patterns are contingent on economic activity. However, they are also the reflection of hard and soft infrastructures that co-produce the urban

fabric. This means that the physical infrastructure of pipes, wires, roads and buildings is both predicated on and shapes the soft infrastructures of codes, rules, conventions and laws. These hard and soft infrastructures themselves are imbricated in culture, politics, economics, science and values. Modernist cities of the 20<sup>th</sup> century have set expectations about how cities should be built and what services should be available, and these were developed in a period of abundance – abundance of fossil fuels, water, materials and money. Their functioning is, in the best of circumstances, based on knowledge and rules. For a post carbon city, the complex system that has created and upholds the modernist city, must be rethought and revised.

### **POLICY/PRACTICE IMPLICATIONS OF RESEARCH**

Bottom-up data is difficult to obtain, but critical, especially coupled with life-cycle analysis and political ecological analysis. Not only does the bottom-up data empirically show who is using what and where to do what, but with an understanding of the supply chain, environmental impacts and impacts on places of origin, it helps to shape policy. For example, cap and trade programs without leakage policies simply displace carbon production elsewhere. Moving toward electrification of the transportation system means new impacts on places of origin for lithium, like the Bolivian Altiplano. Without corporate responsibility mechanisms or ecological planning, those places are simply sacrifice zones.

One of the most difficult parts of the work is the connection between drivers of patterns (World Trade Organization agreements or General Agreement on Tariffs and Trade, tax policy, rules and codes) and resource use. The second is policy change and the unpacking of the system toward de-growth in the affluent North (coupled with strong programs for more equitable distribution of wealth), and sufficient growth in the Global South to achieve healthy and productive lives. The challenge is to move away from an economic system that is dependent on growth in consumption.

Water mapping work has demonstrated beyond a doubt the link between affluence and water use, and more specifically, outdoor water use. Without the bottom up data, there was a lot of confusion about this issue, confounding climate with simple over-use of water. Adding the use of satellite imagery to discern density of greenness, it shows that even in times of water restrictions, landscapes remained green in Los Angeles, demonstrating that landscapes are over-watered, in addition to the use of inappropriate plants in the Mediterranean climate zone. In Southern California, water is pumped over the Tehachapi Mountains, making water conveyance the single largest energy user in the state. The water/energy nexus is very strong.

### **KNOWLEDGE GAPS AND NEEDS**

There are many knowledge gaps and needs to change an economy predicated on growth and its reliance on fossil energy to do so. Those who quantify carbon must look at bottom-up data to understand how carbon fuels move through the economy and are embedded in all aspects of urbanization, from moving water into cities to fueling sewage treatment plants, to transportation, manufacturing and more. This understanding must be linked to policy drivers, whether sanitation codes, engineering specifications, or incentives that continue to make using carbon-based fuels less expensive than alternatives. There is a great deal of research that must be conducted on scale relative to alternative energy production and distribution, for example, what energy can be produced with distributed generation, and what can be supplied from more decentralized locations (e.g., solar vs. biogas). These also need to be linked to urban morphology – how much space in cities is needed for this kind of energy generation? How much space in cities should be devoted to stormwater capture and ground water recharge? Can cities be reengineered, and what steps are involved to do so? What are the lifecycle impacts of different construction types and transportation modes? All of these have important material and energy implications that must be quantified and linked to politics, economics and

justice concerns if we are to move toward lower carbon futures.

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Peter Marcotullio, Hunter College – City University of New York, New York, NY, USA

*Urban greenhouse gas emissions footprints: Meanings and methodological issues*

### SUMMARY

Experts suggest that cities are responsible for up to 75% of global anthropogenic greenhouse gas emissions. These estimates are generated in different ways, many of which involve material flows analyses. Given data availability, definitional issues and research design differences, however, greenhouse gas emissions results for the same location can vary significantly. Indeed, some have argued that given these differences, it is difficult to make comparisons between carbon accounting results between cities. This study examined differences in urban greenhouse gas emissions accounts conceptually and empirically. It reviews differences in methods used in a number of different reports and what these differences mean for policy. Provided is a case study of different greenhouse gas emissions results for New York City, highlighting the similarities and differences in approaches and findings. Given significant differences in results, care is needed when using greenhouse gas emissions in findings for policy development.

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Alexandros Gasparatos, University Of Tokyo, Tokyo, Japan

*Diet changes in Tokyo and their environmental impact*

### SUMMARY

Japan has experienced a radical dietary transition since the 1960s, which involved large increases in meat consumption. The increasing domestic meat demand contributed significantly to the intensification of the Japanese livestock production system. Considering that urbanization has been a key driver of this transition, the aim of this study was to explore the environmental consequences of

Tokyo's increased appetite for meat. By analyzing secondary data collected from national and local authorities, it quantified the amount of land and the natural capital (quantified as emergy) that was appropriated in different parts of Japan to cater for the meat consumed in Tokyo. The results show that significant amounts of land and natural capital have been appropriated in areas close to Tokyo. In 2010, approximately 40% and 50% of the natural capital appropriated for producing respectively the beef and pork consumed in Tokyo was appropriated in the Kanto area (essentially Tokyo's peri-urban area). These results imply that despite Tokyo being a global city, it still relies heavily on its adjacent areas for the meat it consumes. Consequently, the application of emissions factors calculated by life-cycle analyses of Japanese livestock production systems shows how such diet shifts can be responsible for an important fraction of greenhouse gas emissions from the city.

### KEY LESSONS LEARNED

It is possible to locate the areas where the food consumed in cities is produced and quantify associated environmental burdens. However, it may not be possible for all food commodities, particularly bulk commodities and commodities that are dominating the food processing industries (e.g., vegetable oils, corn, wheat, soy, sugar, etc.)

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Joshua Newell & Joshua Cousins, University of Michigan, Ann Arbor, MI, USA

*Extending urban metabolism through a political-industrial ecology of water supply infrastructure for Los Angeles*

### SUMMARY

Three 'ecologies' - Marxist ecologies, industrial ecology and urban ecology - have emerged as the primary thought traditions to conceptualize urban space as a 'metabolism.' Some theorize it as stocks and flows of materials and energy; others, as complex, dynamic socio-ecological systems; and still others, as hybridized socio-natures that produce uneven outcomes. Through literature review (1965-2012) and bibliometric analysis, this presentation mapped



these scholarly islands and unveiled how disciplinary cultures shape the metaphor. Urban metabolism is proposed as a 'boundary object' to enable cross-fertilization through collective empirical experiment and interdisciplinary friction. Towards this end, a blend of theory and method from urban political ecology and industrial ecology was made by focusing on the water supply metabolism of the city of Los Angeles, which sprawls for thousands of miles across the American West. Specifically, GIS fused with a traditional life-cycle assessment (LCA) approach to quantify the energy and emissions burden of the various water supply sources and political ecology methods was used to better understand the equity and governance dynamics of the metabolism. By illustrating how decisions about system boundaries, emissions factors and other building blocks fundamentally shape the end result, this intervention at once destabilizes and grounds the LCA enterprise. LA's water supply metabolism also reflects particular historical circumstances and strategic new paradigms to secure water resources and mitigate emissions. Combining approaches in industrial ecology and urban political ecology yields fruitful insights such as these, and will extend understandings of the city and its processes.

### **KNOWLEDGE GAPS AND NEEDS**

There is a need to deepen the understanding of the multiple dimensions of material and energy stock-flow dynamics.

We must move beyond the 'methodological city-ism' that pervades urban sustainability research.

Scholars should be trained in both industrial ecology and political ecology.



# Session 53 Urbanization, agricultural land loss, and food security

## SESSION ABSTRACT

Urbanization has tremendously changed natural and human landscapes on this planet, and at the same time has profoundly influenced the structure and functioning of ecosystems. Land transformation is one of the most influential manifestations of these changes as agricultural lands, forests and grasslands are converted to urban land. Some nations in the Global South are expected to lose up to half of their national crop yield value (Reitsma, Barthel, Burak and Seto-in review). Such losses are likely to increase dependencies on food imports for many countries and significantly add to the multiple stressors on the global food system as well as increase risks for detrimental teleconnections with rising urban demands for meat, dairy products, vegetable-oils and luxury foods (de Haen et al., 2003; Ruelli et al., 2013, Seto et al., 2012). There is also a need for continuing discussion on sustaining and even increasing agricultural productivity to guide future policy making and land management, considering the rapid urbanization in the developing world, especially in Asia and Africa.

Less studied is how urban expansion over proximate cultivated lands will impact the food security of urban inhabitants. Urban governments generally disregard food storage, proximate agricultural lands and local skills to produce food as obsolete (Pothukuchi and Kaufman, 2000; Barthel et al., 2013). Foodstuffs under normal conditions can be brought in cheaply from elsewhere, via the global food system (Porter et al., 2011; Fraser and Rimas, 2010). While such high global connectivity between cities and remote food supplies build resilience during medium to severe crises, sudden severances of supply lines may pose major threats to urban food security (Barthel et al., 2013; Newman et al., 2009).

The session highlighted case studies that model land use changes in metropolitan landscapes with focus on spaces of food production; those that assess the long- and short-term values of agricultural space in historical metropolitan landscapes including peri-urban spaces; and studies that track the place of urban farming in metabolistic shifts and trends over the long-term in different energy regimes.

*Keywords: urbanization, agriculture, food security, ecosystems, land use*

## ORGANIZERS

Stephan Barthel, Stockholm Resilience Centre, Stockholm, Sweden

Xiangzheng Deng, Chinese Academy of Sciences, Beijing, China

## PRESENTATIONS

**Ying-Chieh Lee**, Lee-Ming Institute of Technology, New Taipei City, Taiwan

Shu-Li Huang, National Taipei University, Taipei, Taiwan

*The effects of urbanization on the loss of ecosystem services of agricultural landscape in Taiwan's western coastal plain*

## SUMMARY

This research focuses on the changes in spatial patterns of agricultural land in the western coastal plain of Taiwan and the effects of peri-urban agricultural land use change on a suite of agro-ecosystem services. The changes in area and landscape pattern of agricultural land in Taiwan's western coastal plain between 1971 and 2006 were examined. In order to better understand the relationship between the

agricultural landscape change and loss of agro-ecosystem services, landscape metrics and ecological energetics analysis were applied in this research.

### KEY LESSONS LEARNED

The results of the analysis reveal that agro-ecosystem services are related to the spatial configuration of paddy rice fields. Maintaining larger tracts and preventing paddy rice fields from fragmentation will help to improve the environmental sustainability of the agricultural landscape. With careful planning, farmland can help urban areas adapt to climate change and improve resilience to extreme weather events.

### POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Farmland, as a part of urban green infrastructure, plays an important role in regulating urban microclimate and flooding. Measuring and assessing the spatial attributes associated with agro-ecosystem services can hold the potential to support performance-based guidelines for planning in peri-urban landscapes. Guidelines can be provided for planning and managing land use change in peri-urban landscapes so as to optimize agro-ecosystem services.

### KNOWLEDGE GAPS AND NEEDS

Landscape metrics and ecological energetics analysis were applied in this research to study the relationship between the agricultural landscape change and the loss of its agro-ecosystem services in peri-urban landscapes. Further research is needed to articulate the relationship of each specific agro-ecosystem service with its landscape composition and configuration characteristics.

In a study area as large as the western coastal region of Taiwan, there exists a great opportunity to monitor the relationship between agro-ecosystem services and land use change over time, with the goal of informing landscape planning of environmentally- and ecologically-responsible modes of change.

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**Kazuaki Tsuchiya**, University Of Tsukuba, Tsukuba, Japan

Yuji Hara, Wakayama University, Wakayama, Japan

Danai Thaitakoo, Chulalongkorn University, Bangkok, Thailand

*Linking food and land systems: Opportunities and challenges for sustaining peri-urban agriculture across growing and shrinking cities*

### SUMMARY

Peri-urban agriculture has been recently recognized as a vital source of sustainability both in growing and shrinking cities. Traditional land use planning, which draws a line between urban and rural areas, has often failed to encourage farmers to continue their activities near urban areas and has resulted in the loss of production capacities and multifunctional values. Opportunities and challenges in applying a novel paradigm for sustainable peri-urban agriculture were examined in this research, which combined a food systems approach with farmland protection. Bangkok, Thailand and Osaka, Japan are the case study sites.

### KEY LESSONS LEARNED

These two studies together indicate that sustainable peri-urban agriculture cannot solely depend on producers and landowners, but need to involve consumers and non-landowners.

The traditional rural-urban dichotomy must be challenged to realize collaboration among multiple food-related actors.

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**Xiangzheng Deng**, Qian Zhang, & Zhihui Li, Chinese Academy Of Sciences, Beijing, China

Chenchen Shi, Beijing Normal University, Beijing, China

*Impacts Of Urbanization On Agricultural Land: A Model-Based Analysis In China*

### SUMMARY

The explicit impacts of urbanization on agricultural land changes were analyzed using the highly urbanized region of eastern China as the area of

study. An econometric model incorporated socio-economic and policy factors to analyze the impacts of different urbanization modes ('town', 'village' and 'city') on agricultural land changes. The results show that although urbanization has an effect on the changes of cultivated land, the effect is marginal. Moreover, the expansion of built-up areas in different urbanization modes causes varying impacts on changes in agricultural land in different regions.

### KEY LESSONS LEARNED

Net cultivated land actually increased during the study period (1986 to 2000). Although newly cultivated area rose, average potential agricultural productivity actually fell. Despite this, when examined in the aggregate for the entire period, the effect on total agricultural potential output was negligible.

Economic growth is the major determinant of any changes in cultivated land use. Social, economic and geophysical factors, such as industrial structure and population growth, play an important role in influencing urbanization.

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**Qian Zhang** & Xiangzheng Deng, Chinese Academy Of Sciences, Beijing, China

*Agricultural land loss and urbanization in China: Analysis from the perspective of land competition*

### SUMMARY

Growing competition for finite land resources is reshaping land cover and land use in China. Previous studies indicate that China's urban development subsumed a large amount of high quality agricultural land in the past two decades. Simultaneously, an almost equivalent amount of agricultural land has been reclaimed, but the quality of newly reclaimed land is relatively low. Apparent conflict between urbanization and agricultural production brings increasing pressure on high quality agricultural land. Given the rapid urbanization trend in China, where are the optimal places for urbanization? Should we urbanize fertile agricultural land? How can we coordinate the conflict of land use?

### POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Indicators of land quality along with quantity should be included for the protection of agricultural land resources and the development of land management policies.

### KNOWLEDGE GAPS AND NEEDS

Should trans-regional agricultural land area/productivity be balanced within individual provinces? This must be determined with the aid of land use efficiency analysis including spatial variation evaluation of gains and losses for converting land from agricultural to urban use.

There is a need for improving how the potential productivity of agricultural land is calculated as well as how the efficiency/gains of urban land expansion, and the spatial variation of gains and losses for those areas converted from agricultural to urban use are evaluated.



# Session 54 A new science of cities for responding to global environmental change

## SESSION ABSTRACT

In the last few years, there has been an intensification of efforts for a new urban research synthesis, connecting seemingly disparate topics or themes and integrating disciplinary knowledge. In this perspective, cities are viewed through the lenses of complexity science, geography, urban economics, regional science and sociology. They are typically examined as interlinked systems of networks and flows. Emergent properties of these systems (such as scaling and power laws) are being 'micro-founded' and their policy relevance is further explored. It can be argued that cities are the most important socio-economic entity of the 21<sup>st</sup> century, the century which will see the completion of humanity's march towards becoming an urban species. Hints abound regarding the existence and effects of generative processes common to urban life across time and across geography. The scientific challenge is to build formal and predictive models for the origin and development of cities.

Whether a new 'science of cities' or 'urbanization science' is being discussed, what remains to be further examined is the theoretical and policy relevance of the new findings for global environmental change research. What are the implications of the new lenses and knowledge produced within a new urbanization science for our capacity to respond to climate change? What are the energetics of cities? Urbanization is good for development and for innovation, but will these always counteract the environmental impacts of the very same processes of urbanization? How do we envision the findings affecting our capacity to better manage biodiversity-rich landscapes? Is a new science of urbanization capable of addressing major themes in the global environmental change literature, such as low-probability, high-impact events or tipping points in ecosystems?

*Keywords: urbanization science, urbanization, synthesis, complexity*

## KEY DISCUSSION POINTS

There are difficulties in prescribing a normative view of urbanization.

Why does the study of policy implementation garner less funding than the data collection that would inform implementation?

Research on sustainability indicators (e.g., water, energy and food consumption) must include both the city and the sources of these commodities.

It may be difficult for local governments and planners to connect with an 'urbanization science'.

It is difficult to predict urban growth/change based on historical analysis. Urbanization science might help find the correlations, but not necessarily help find the solutions.

Not all research needs to be co-designed, and not all urban researchers need to focus on the local. The time frames in which researchers work is much different than the time frames of practitioners.

There is a debate between urbanization scientists as to whether or not there should be a single law of urbanization. Is there one single urbanization trajectory or are there multiple ones specific to regional differences?

## ORGANIZERS

Michail Fragkias, Boise State University, Boise, ID, USA

Jose Lobo, Arizona State University, Tempe, AZ, USA

## PRESENTATIONS

Barry Newell, The Australian National University, Canberra, Australia

*Collaborative conceptual modelling: Unraveling the complexity of urban systems*

### SUMMARY

Collaborative Conceptual Modelling (CCM) is a practical meta-method designed to guide the integrated use of the concepts and tools of applied history, system dynamics and scenario planning with its use in search for dominant feedback structures. CCM consists of six 'co-evolving activities' that are labelled with key questions: What is the challenge? What is the story? Can I see how you think? What drives system behavior? Where are the leverage points? Can we have new eyes? Embedded in each activity are well-defined protocols that can help a cross-discipline, cross-sector group to develop a shared understanding of urban dynamics and develop more sustainable policies and practices.

### KEY LESSONS LEARNED

Cities are complex adaptive systems. When managers take action in such a system a spectrum of unexpected outcomes emerges, driven by interactions between the parts of the system. Overwhelmingly, these outcomes are unwanted and cannot be anticipated on the basis of studies of the parts taken separately. A comprehensive view is needed. As soon as one tries to look at the whole city, however, it is overwhelming in its complexity. This research focuses on ways to escape from this 'complexity dilemma' (for a summary see Newell and Proust 2012, Introduction to Collaborative Conceptual Modelling). This work has led to the following views:

A new science of cities needs to have a mutually agreed upon theoretical and methodological framework. System Dynamics, as developed initially at the Massachusetts Institute of Technology (Forrester 1961), can provide a significant component of the required theory. Nevertheless, like any theory,

the framework must capture essential invariances if it is to provide useful guidance, and suggest ways to escape from the complexity dilemma. Research has led to the conclusion that these essential invariances include relatively simple, generic feedback structures, such as the 'system archetypes' popularised by Senge (1990). These feedback structures can be thought of as 'invariances of organization' (Laszlo 1996).

A science of cities, if it is to support efforts to respond to global change, must have an urban dynamics core. 'Urban dynamics' is defined to be the study of the way that the state of a city changes over time in response to both endogenous and exogenous forces. Of particular importance is the interplay between the accumulations (or stocks) that represent the time-dependent state variables of the urban complex and the state-change processes (or flows) that change those accumulations.

There are two sets of critical interactions that must be taken into account in any science of cities: (a) cross-sector feedback interactions that can dominate the dynamics of urban systems, and (b) knowledge-generating discussions between people from many different disciplines, sectors and walks of life. Because no one person can see the whole system, effective integrative discussions are absolutely necessary if cross-sector feedback structures are to be identified and understood. Nevertheless, the effort required is rarely deemed worthwhile. Focused dialogue of the required openness and depth is rare. A key lesson is that, while truly effective communication is difficult and time consuming, it is a critical enabler of any effort to unravel the complexity of urban systems (Newell 2012).

### POLICY/PRACTICE IMPLICATIONS OF RESEARCH

The single most important implication for policy/practice is the need to develop a more integrative, cross-sector approach to policy design and management. The persistence of the major problems facing urban communities is due largely to the highly fragmented, silo-based approach taken at all levels of governance. Cross-sector feedback



effects are generally overlooked, greatly increasing the prevalence of policy resistance and failure. The possibility that an action taken in one sector can feed back, through other sectors to undercut the initial management initiative, is rarely considered. The fact that these unwanted outcomes are usually delayed by years hides the feedback effects, and so exacerbates the situation. Such outcomes can be minimized only by focused dialogue between people from different sectors, carried out by individuals who understand the basics of feedback dynamics.

### KNOWLEDGE GAPS AND NEEDS

To what extent can significant aspects of the dynamics of an urban complex be captured by low-order system-dynamics (LOSD) models? There is a need for more theoretical research into the number of variables that an urban system can 'see'. Existing research suggests that this is a small number.

How can policymakers and managers be helped to understand the critical role of cross-sector feedback? There is a need for case studies (both modern and historical) that demonstrate the impact of cross-sector feedback in urban systems.

How can system dynamics concepts and tools be used to craft a shared cause-effect language that can support effective communication across discipline and sector boundaries? There is a need for much more work on the difficulties of effective communication between people with different backgrounds, and on the development of ways to improve communication.

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Matthias Garschagen, United National University, Bonn, Germany

*Social and economic tipping points in urban adaptation potentials: Reason for concern?*

### SUMMARY

The research aimed at fostering scientific engagement with tipping points in urban adaptation processes, hence, contributing to a new science of cities for responding to global environmental change. It built on lessons from Asian, African and European cities,

drawing on empirical research findings on adaptation processes at city, ward and even household level in Vietnam. The findings suggest that many types of tipping points in adaptation processes and capacities can be observed in urban systems, ranging across hard and soft aspects and relating to different scales and actors. A first-order taxonomy of such adaptation tipping points in urban systems was thus developed. The presentation discussed epistemological implications for a future science of cities as well as practical lessons for urban risk and adaptation governance (e.g., how to incorporate tipping points in adaptation 'planning').

### KEY LESSONS LEARNED

There are significant gaps and mismatches between state and non-state action for urban adaptation. These gaps hamper comprehensive adaptation action.

While 'tipping points' are intensively discussed in terms of climate change hazards and the (expected) impacts on (urban) systems, their role in adaptive capacities and actual adaptation processes remains largely neglected. A stronger consideration - and better understanding - of economic, political and cultural tipping points in urban adaptation processes is of key relevance, in order to plan for urban adaptation.

Urban adaptation is still predominantly understood in the context of the adjustment of physical infrastructure. The challenges for institutional adaptation in terms of adjusting and rethinking planning mechanisms and practical tools for urban administration and governance are far less considered and understood. The need for such institutional adaptation in the sense of an 'adaptive urban governance' are particularly relevant in highly transformative countries undergoing rapid change in their socio-cultural and politico-administrative systems. Key examples from this research illustrates the need for institutional adaptation in urban governance and selected options for pushing such change forward.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Adaptation planning must be more considerate of the integration of state and non-state action for adaptation. To date, adaptation in both domains is largely happening in two separate ‘worlds’ (e.g., large-scale dyke construction vs. small-scale coping with periodic flooding at the household level). Adaptation governance and financing must find new ways of integrating these two domains (e.g., through re-channeling national adaptation funds for supporting individual small-scale adaptation).

The assessment of needs and the timing of future urban adaptation funding must consider tipping points in urban adaptation processes (e.g., overhaul of current dyke systems or population collapse if/when parts of cities become inhabitable).

## KNOWLEDGE GAPS AND NEEDS

Understanding adaptation decisions of the private sector in and around urban areas (currently the focus is predominantly on ‘the household level’ or ‘the government’).

Overcoming conflicts between urban policies for climate change mitigation vs. adaptation as well as within each of these two domains.

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Angel Hsu, Yale University, New Haven, CT, USA

*Urban sustainability metrics: Smart-scaling for cities*

## SUMMARY

This presentation was an introduction to the work of the Environmental Performance Measurement Program at the Yale Center for Environmental Law & Policy, the Environmental Performance Index. Which indicators should be measured, can and cannot be measured, and data availability were discussed and supplemented with the following questions:

How can the scope of urban sustainability be determined?

What types of data, measurement and indicators are needed?

What is the best way to design a framework that can link across sectors?

How can new data be sourced?

## KEY LESSONS LEARNED

Many urban sustainability indicators are not measurable, plus there is a lack of consensus on which indicators to measure.

Comparability and bench-marking are key to choosing data types, measurements and indicators.

Data availability between cities is inconsistent.

## KNOWLEDGE GAPS AND NEEDS

Typologies based on perception and quantitative variables.

A scientific/knowledge-based framework for urban sustainability indicators.

Urban data governance: How are decisionmakers using data? What information is needed to make improved decisions, i.e., urban sustainability?

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Michail Fragkias, Boise State University, Boise, ID, USA

*A new science for cities and global environmental change: An overview*

## SUMMARY

This research examines CO<sub>2</sub> emissions and energy use from a system of cities perspective, and the relationship between city size, CO<sub>2</sub> emissions and energy use for U.S. metropolitan areas using a production accounting allocation of emissions. Larger cities in the U.S. are not more energy and emissions efficient than smaller ones and do not exhibit gains from economies of scale with regard to emissions. For the time period of 1999–2008, CO<sub>2</sub> emissions and energy use scale proportionally with urban population size. Contrary to theoretical expectations, larger cities are not more emissions efficient than smaller ones.

## KEY LESSONS LEARNED

Scaling analysis is important when examining issues at the intersection of urbanization and global environmental change. Scaling is simply an emergent relationship between systemic size and emissions. Emissions in urban areas belong to a broader paradigm since every system needs to consume energy to maintain structure and order. The existence of approximate scaling phenomena for urban areas — documented using a variety of socio-economic metrics — is an indication that there are generic social mechanisms and properties of social systems at play across the entire urban system. Mechanisms such as networks and flows, non-linearities and feedback loops integrate complex interactions among the individuals, households, firms and institutions living, residing and operating in these spaces, leading to emergent phenomena such as scaling laws.

The analogy between urban metabolism and biological metabolism may have empirical limits. Cities exhibit characteristics that make the natural organism analogy difficult, such as the urban phenomena that produce super-linear scaling.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

These results have important energy policy implications for a rapidly urbanizing planet since they reveal the importance of urban scale/size relative to factors such as population density and wealth.

Policymakers must renew their attention on issues of distributions of city sizes within national urban systems; size trumps the effects of all other variables (such as population density and wealth) in explaining variation in CO<sub>2</sub> emissions and energy use.

A focus on urban densities and wealth is still required, as these factors are critical for addressing various facets of global environmental change related to urban development. But as (new) world cities continue to grow, policymakers need to consider the CO<sub>2</sub> emissions and energy use effects of urban size and contrast it to the effects of urban form, building materials and transportation network structure.

The intuitive interpretation of the linear to superlinear scaling finding can be explored first through the analogy of urban metabolism. This finding creates a paradox when one considers that in nature, as organisms grow in size, they become more efficient. A linear to superlinear scaling in CO<sub>2</sub> emissions and energy use suggests no gains and losses in efficiency from larger cities. This casts doubt on the hypothesis that urban systems function similarly to biological ones.

A 'closed system' approach to urban research brings into question the efficacy of using urban size as a climate change mitigation strategy. The results show that, at least in the case of U.S. cities, there are no significant economies of scale with city size and CO<sub>2</sub> emissions and energy use. More recent research points to actual significant diseconomies of scale. Therefore, cities and policies must consider other mitigation strategies that have been shown to have greater impacts on emissions than population size.

Dis-economies of scale with respect to CO<sub>2</sub> and energy use should be viewed in conjunction to the build-up of additional evidence on urban scaling. Any strategic decision on city growth considering sustainability must carefully weigh the implications of urban scale on a variety of urban metrics (including innovation, crime, environmental indicators, etc.). The results contribute to the larger picture of scaling relationships present in urban systems: given that larger cities 'speed up' the process of wealth creation and innovation and do not offer economies of scale in CO<sub>2</sub> emissions, a policy favoring larger city sizes may bring about carbon reductions primarily through technological advancements and eco-innovations.

## KNOWLEDGE GAPS AND NEEDS

Scaling these findings requires an interpretation from economics, combined with an understanding of the nature of greenhouse gas emissions in the US. CO<sub>2</sub> emissions depend significantly on the carbon intensity of the energy source and the drivers of demand for fossil fuels. Several hypotheses can be made on the basis of a decomposition of factors that

drive demand for fossil fuels in localized markets. Expecting a pattern of increased savings in CO<sub>2</sub> in larger urban agglomerations, a linear scaling of CO<sub>2</sub> emissions may signify that larger urban areas are lagging in their capacity to curb demand for fossil fuels proportionally to smaller urban areas. It may be the case that residents in larger urban areas are not incentivized structurally (through urban form) or economically (through energy prices) to demand lower proportions of fossil fuels in their energy mix. Although large urban areas are more innovative than smaller ones, they may lack capacity in steering innovations towards their local markets for fossil fuels. These important hypotheses remain untested and need to be addressed in future research.

The issues associated with emissions and energy accounting methods highlight the limitations of assuming cities as 'closed systems'. This perspective is in large part driven by the dominant conceptualization of a city through its narrow administrative boundaries – a definition of urban areas that drives data collection globally and dominates research practice surrounding urban phenomena. As we build our capacity to associate the increase of a city's size to effects that occur far away from a city's boundaries, we can overcome the data-specific challenge and adopt an 'open system' perspective that could drastically alter our perspective on urban scaling. Through this new perspective, wealth, for example, may be found to be a more significant driver of total urban emissions; this is especially the case when considering emissions that occur in distal locations (or carbon sequestration capacity that is lost in distal places) but can be attributed to the demand of goods and services that arises in specific urban areas.

While scaling laws characterize the structure and order of urban systems globally, whether these specific U.S. results hold for all typologies of cities is subject to further research.

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Karen Seto, Yale University, New Haven, CT, USA

*Why do we need an urbanization science?*

## SUMMARY

Scholars have been studying the city for centuries. Yet only recently has there been a push towards making the study of the urbanization process a scientific endeavor. What are the requisite characteristics of a science, and how can the study of urbanization become a science, or has it already? There is already an emerging science of urbanization, but much more needs to be done for it to be a hypothesis-driven endeavor.

## KNOWLEDGE GAPS AND NEEDS

What does the urban century mean for planetary sustainability?

Are we in a fundamentally different era of urbanization in history? If we are, do the existing theories apply?

Do our theories and models capture contemporary processes of urbanization?

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**Kevin Gurney**, Risa Patarasuk, Igor Razlivanov, Darragh O'Keefe, Yang Song, & Jianhua Huang, Arizona State University, Tempe, AZ, USA

*Hestia. High resolution quantification of fossil fuel CO<sub>2</sub> emissions for cities: From science to policy*

## SUMMARY

Quantification of fossil fuel CO<sub>2</sub> emissions from the 'bottom-up' is a critical element in plans for a global carbon monitoring system (CMS). The space/time explicit emissions data products emerging from this must also have great utility in decision making, and can act as both verification and guidance to greenhouse gas (GHG) emissions mitigation. The Hestia Project has accomplished high-resolution (e.g., building and road link-specific, hourly) quantification of fossil fuel CO<sub>2</sub> emissions for entire urban domains. Data products have been built for the cities of Indianapolis, Salt Lake City and Los Angeles, with work ongoing in Phoenix and Washington DC. This bottom-up quantification is often part of scientific programs (e.g., INFLUX, Megacities Carbon), aimed at a convergent top-down/bottom-up assessment of GHG emissions.

**POLICY/PRACTICE IMPLICATIONS  
OF RESEARCH**

Cities see this information as a communications tool; they are also concerned about continuity and long-term engagement in collecting and utilizing this data.



# Session 67 Forecasting urbanization: Population and land dimensions

## SESSION ABSTRACT

This session encompassed research on spatially-explicit future population estimations, with a particular focus on the integration of population models with land use/land cover models. It brought together researchers from land use change and population modelling in an effort to better understand future population growth in urban environments.

*Keywords: population, forecasting, land use/land cover*

## ORGANIZERS

Carson Farmer, Hunter College - City University of New York, New York, NY, USA

Peter Marcotullio, Hunter College - City University of New York, New York, NY, USA

## PRESENTATIONS

Jun Li, Curtin University, Perth, Australia

Wei Zhou, Zhejiang University, Hangzhou, China

Meriem Hamdi-Cherif, Cired, Paris, France

*Urban population change and its implications for energy demand and carbon emissions in China: An integrated analysis*

## SUMMARY

Demographic change has significant impacts on a country's long-term growth trajectory through savings, consumption and labor market channels. Changes in the population including aging, decreasing family size, migration and urbanization may significantly affect growth prospects for fast-growing developing countries like China. This study analyzed the challenge of environmental sustainability resulting from population and lifestyle changes in

different socio-economic groups in China based on a quantitative analysis within an integrated assessment framework. Both co-integration and instrumental variables methodologies were applied to assess the consequences of demographic change and implications for energy demand and greenhouse gas emissions since the economic reforms commencing in the late 1970s. The empirical findings document that urbanization, changes in population and consumption behavior have contributed significantly to increased carbon emissions. The results are highly significant for policymakers who must adopt new policies to mitigate China's present and future environmental problems.

## KEY LESSONS LEARNED

There is a complex interaction between urbanization, household structure, lifestyle change, consumption behavior and environmental impacts in terms of carbon emissions. Population growth was found to be a significant influence shaping the behavior of carbon emissions change in China over the past three decades.

Extended life expectancy coupled with population ageing will drive per capita carbon emissions growth upwards, suggesting that the Chinese society has moved towards a more carbon intensive lifestyle, in particular younger generations.

Fertility is a positive force on per capita carbon emissions, i.e., higher fertility rates lead to higher per head carbon emissions, suggesting that China's one-child policy has slowed per capita carbon emissions growth.

GDP growth has a strong influence on CO<sub>2</sub> emissions, reflecting the effects of higher income and the manufacturing industry's dominance in China's economic growth.

Open trade has contributed to the growth of carbon emissions as China has become a major destination of outsourced resource-intensive manufacturing in parallel with increased urbanization.

### **POLICY/PRACTICE IMPLICATIONS OF RESEARCH**

To understand the interaction and causality between urbanization and environmental impacts, an integrated approach must be adopted by policy makers; the assessment of policy variables should not be conducted in isolation.

To address the complex relationship between urban growth and environmental change, the synergy between urban and environmental policies is critical; i.e., sectoral policies need to be articulated to enhance overall effectiveness, suggesting the importance of cross-sector coordination and governance efficiency.

It is necessary to reconcile micro- and macro-level policies as individual behavioral changes may have considerable impacts in the aggregate, and a linear top-down policy may be inappropriate to address the bifurcation challenge.

### **KNOWLEDGE GAPS AND NEEDS**

Greater confidence is needed to predict the impacts of individual behavior change on the aggregate shift in energy consumption and greenhouse gas emissions.

Heterogeneity among agents must be better accounted for in any future framework of studying urbanization and global environmental change.

A hybrid approach (linkage between top-down and bottom-up models) which takes into account urban and rural consumption behavior will be useful in advising the long-term urban and environmental policy in developing countries like China.

One possible improvement is to embrace an agent-based modelling approach which explicitly integrates individual characteristics in macro-level socio-economic and environmental policy simulations.

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İnci Güneralp, **Burak Güneralp**, & Ying Liu, Texas A&M University, College Station, TX, USA

## *Changing global patterns of urban exposure to flood and drought hazards*

### **SUMMARY**

Studies that quantify the human and economic costs of increasing exposure of cities to various natural hazards considering climate change, an increasing population and economic activity assume constant urban extent. Accurate estimates of the potential losses due to changing exposure of cities, however, require that we know where they will grow in the future. This research offers the first-ever estimates of changing exposure of urban infrastructure to floods and droughts due to urban land expansion from 2000 to 2030. The findings show that even without factoring in the potential impacts from climate change, the extent of urban exposure to flood and drought hazards will increase by 2.7% and almost double, respectively, by 2030. Several policy options exist to safeguard urban infrastructure from flood and drought hazards. These range from directing development away from flood- or drought-prone zones to large-scale adoption of 'green infrastructure'.

### **KEY LESSONS LEARNED**

Knowing where cities will grow is important to understand how their exposure to hazards will change.

Emerging coastal metropolitan regions in Africa and Asia will have larger areas exposed to flooding than those in developed countries.

Even without climate change, the extent of urban areas exposed to floods and droughts would at least double by 2030.

### **POLICY/PRACTICE IMPLICATIONS OF RESEARCH**

Decisions made today on managing urban growth in locations exposed to these hazards can make a big difference in mitigating likely losses due to floods and droughts in the near future.

Although forecasts show significant urban expansion in high-frequency flood zones, governments can potentially preempt these patterns and prevent



development in flood-prone zones. This would protect natural habitats that would reduce flooding at a considerable cost (assuming institutional and financial capacity to undertake these actions exist).

In countries located in arid regions, national governments can implement ambitious plans to bring water to their growing cities if they have access to sufficient financial resources.

In cities located in drylands, water loss due to leakage from water distribution systems becomes especially troublesome in drought episodes during which excessively dry soils exert pressure on building foundations, transportation systems, pipes and joints. It will be important to minimize such losses by increasing the efficiency and effectiveness of monitoring and maintenance of the infrastructure - both new and existing.

To minimize the risks to urban infrastructure posed by unforeseen changes in demands and environmental conditions, future urbanization presents an opportunity for large-scale adoption of 'green infrastructure' or 'eco-efficient infrastructure' that represent long-standing principles of durability, flexibility and energy-efficiency in infrastructure construction.

### KNOWLEDGE GAPS AND NEEDS

A challenge in research on global environmental change is the incorporation of feedbacks among the socio-economic and biophysical systems as well as the uncertainty inherent in any forward-looking assessment.

A more comprehensive, systems-oriented study of flood and drought hazards is needed to understand the potentially compounding impacts of socio-economic and biophysical dynamics on people and infrastructure that account for humans' impact on water and climate.

The influence of humans in the form of water abstraction, land change and the construction of large infrastructure on regional and global hydrology remain largely absent in the current studies. Incorporation

of these interactions and accounting for uncertainty would lead to an informed understanding of exposure and vulnerability in urban areas as well as how these will change in over time.

Overcoming the challenges of inherent limitations to urban expansion forecasts, e.g., excluding potential changes in transportation networks associated with urban development and ignoring differences among various urban land uses or between formal and informal growth, could better inform exposure and vulnerability assessments as well as decision making.

A potential improvement to the global urban forecasts used in this study would be to utilize a scenario approach where each urban expansion scenario is linked to a specific representative concentration pathway (RCP) employed by the Intergovernmental Panel on Climate Change, thereby ensuring consistency, accurate accounting of uncertainty and the incorporation of the feedbacks between socio-economic and biophysical components.

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**Peter Marcotullio** & Carson Farmer, Hunter College, City University of New York, New York, NY, USA

*Generalized agent-based model for urbanization projections to the year 2100*

### SUMMARY

This presentation shared preliminary results from the development of an agent-based model focused on cities as agents, in order to project urbanization to the year 2100. The model presented urban change as a multi-dimensional process that involves demographic and other socio-economic change, built environment transformations (buildings and infrastructure), land use change and changes in the natural environment. Data inputs came from different sources for each of these four dimensions. Baseline results are shown for five countries in different regions around the world (China, Asia; United States, North America; Brazil, South America; South Africa, Africa; United Kingdom, Europe). Both the preliminary model as well as the modeled outputs by decade for each of these nations

were presented including modeled results from 2000 to 2010 to historical patterns in a selected area.

### **KEY LESSONS LEARNED**

Over time there has been a shift and a 'bulge' in the lower latitudes (50° South - 85° North) comparable to the biodiversity gradient, i.e., people currently live in areas of low biodiversity, but in the future they are predicted to live in areas of higher biodiversity.

### **POLICY/PRACTICE IMPLICATIONS OF RESEARCH**

Understanding the connections between future urbanization and the overlaps with biodiversity hotspots, including how many species might be affected, will offer insight into if and how future urbanization could benefit biodiversity and inform urban planning and conservation policies.

### **KNOWLEDGE GAPS AND NEEDS**

This is preliminary work that will require building upon the framework that already exists towards creating a baseline model against which additional models can be validated; historical examples and more theory development and integration as well as the gathering of further data (e.g., land use, economic activity) will be needed.



# Session 72 Urban Weather and Climates: Assessments and Responses

## SESSION ABSTRACT

Although currently only a small fraction of the Earth's land is considered urban, the spatial coverage and density of cities is expected to rapidly increase in the near future. The United Nations estimates that by the year 2025, 60% of the world's population will live in cities. With further urbanization, local and regional-scale changes to urban ecological structure, ambient pollution levels, biodiversity composition, human thermal comfort as well as nutrient and energy flows within cities and its surrounding areas will arise. Thus, research based on observational, modeling and/or remote sensing platforms across cities would be needed to document these alterations. The challenges facing urban climate research across all spatial scales are further compounded by the influence - and impacts - of global climate change, such as higher and more extreme temperatures, and variations to precipitation regimes. These impacts could potentially increase the physical exposure of urban residents as well as complicate the adaptive and/or mitigation responses of municipal governments. The interactions of these multi-scale impacts would thus present unique challenges related to residents, urban planners and other stakeholders in cities.

*Keywords: climate, weather, meteorology, climatology, climate hazards, urban heat island, precipitation, air pollution*

## KEY DISCUSSION POINTS

Next steps research must take predicted temperature increases, as they relate to thermal comfort, to also predict related energy increases as a result of air-conditioner (AC) usage.

Relative humidity, or more accurately 'vapor pressure', is an important factor in the tropics, as it plays a role in human health and thermal comfort and must be included in future models.

Where is the science in terms of generating typologies or classifications in understanding what types of underlying conditions matter in what places with respect to certain types of vegetation, urban form, building materials, in addition to the oft-heard about anthropogenic sources (AC, cars, etc.)? This will be important given differences in latitudes and capacities of cities in terms of using building materials and investments in simulations and projections for identifying the most optimal mitigation policies (emerging country cities).

There is potential in more temperate regions and sub-tropics where much of the literature is focused, and where doing more comparative analyses would be possible.

In order to address urban climate and impacts of climate change, background conditions must be known for a specific city as well as the elevation or latitude, etc. There are so many factors included in the urban climate that what might work in Paris, for example, as a mitigation strategy may not work in a city in a similar latitude.

Cities can bring anomalies or modification in rainfall patterns as well as snow and lightning (increased due to aerosols); urban heat island (UHI) is the most studied, but these other factors are key for human health (e.g., water cycle changes and disease emergence).

What are the key entry points or co-benefits of mitigating the UHI and for larger conversations around climate change mitigation? In many cases the tools to mitigate the UHI are locally focused and framed in this manner, allowing for the simultaneous attention to climate change.

## ORGANIZERS

Chandana Mitra, Auburn University, Auburn, AL, USA

J. Marshall Shepherd, University of Georgia, Athens, GA

## PRESENTATIONS

**Madhumita Jaganmohan & Nina Schwarz**, UFZ, Leipzig, Germany

Sonja Knapp, UFZ, Halle, Germany

*A study on the cooling effects of green spaces onto the residential areas of Leipzig, Germany*

### SUMMARY

Ecosystems provide cities with various services, of which microclimate regulation is one of the most easily perceivable. Urban green cover mitigates heat caused by built-up structures. The aim of the study was to quantify the strength of the cooling effect of a green space, how far it reaches into its surrounding residential environment, and how this temperature gradient is driven by the size and shape of the green space as well as its distance to the city center. This presentation gave preliminary results on the effect of park characteristics onto the cooling effect in the city of Leipzig, Germany.

### KEY LESSONS LEARNED

It is assumed that temperature increases as distance from the greenspace increases, but in a sample size of 66 parks, this is not true in many cases, e.g., 25 percent of greenspaces are found to be slightly warmer than their surrounding distention areas (dependent upon vegetation type and size of greenspace).

### POLICY/PRACTICE IMPLICATIONS OF RESEARCH

The spatial configuration of urban green spaces is directly related to aspects of land sharing (numerous small green spaces) and land sparing (few, large urban green spaces) in an urban context.

Understanding which urban form is more important for influencing the cooling effect helps to provide valuable information for urban planners.

**Chandana Mitra**, Auburn University, Auburn, AL, USA

Rupsa Bhowmick, Jadavpur University, Kolkata, India

Devendra Pradhan, Indian Meteorological Department, Kolkata, India

*Urban Heat Island Intensity Of Kolkata City And Methods To Ameliorate Its Impact*

### SUMMARY

Located in eastern India, Kolkata city is one of the four largest megalopolises in India, with a population of over 15 million (Census of India, 2011). To contain this huge populace, the city has been going through major land use/cover changes in the recent decades. The eastern part of the city is seeing major transformation, where the wetlands are being replaced by built-up surfaces. This transformation is bound to have some impact on the microclimate of the city, especially the temperature patterns. Thus, it is important to quantify the urban heat island (UHI) intensity across the length and breadth of Kolkata to see how temperature patterns are changing. A three-month pilot study (during April, May and June, the hottest months of the year) was conducted to measure the UHI magnitude and intensity.

### KEY LESSONS LEARNED

Studying the tropics is important, i.e., heatwaves in this area are researched much less when compared to temperate regions and subtropics, despite their prevalence.

It will be important to focus UHI research on small-to medium-sized cities, as they will grow the fastest into the future. Research cannot easily be replicated and applied to all parts of the world, as many local and regional variations and challenges exist (e.g., regarding placement and 'disappearance' of temperature recording sensors).

Ultimately, human welfare is the greatest concern, so the communication of basic knowledge to city residents is key.

Urban approaches that are tailor-made for adaptation and mitigation (to some extent) are challenging, but must be undertaken and should involve local experts.

### **POLICY/PRACTICE IMPLICATIONS OF RESEARCH**

Increases in urban flooding and heat waves will impact human health and infrastructure in high-density cities of the developing world. Urban precipitation and urban heat island research will help build policies for risk reduction and resilience.

If the gap between urban climate researchers and government officials and planners can be bridged, this research will aid in the development of more sustainable and resilient urban environments.

### **KNOWLEDGE GAPS AND NEEDS**

Overcoming a lack of readily available and continuous precipitation and temperature data, especially in developing countries that hampers good research.

More research on cities globally to contrast and compare outcomes will help inform future planning efforts.

The use of newer satellite-derived datasets for land cover, precipitation, temperature and aerosols to conduct robust and extensive research on the urban environment.

Greater communication between the academicians and practitioners at the local city level.

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Andreas Matzarakis, University Of Freiburg, Freiburg, Germany

*Estimation of urban bioclimate by micro scale models for the development of mitigation and adaptation possibilities*

### **SUMMARY**

In order to analyze urban bioclimate and climate, several input and output parameters are required. The quantification of thermal bioclimate assessment

methods based on the human energy balance builds the basis of all the known thermal indices. Some data and information can be obtained from measurement or simulated by micro-scale models. This information, in combination with shade, sunshine duration, wind speed and direction in simple and complex environments can be derived by RayMan and SkyHelios models. The models are not only able to calculate, but also visualize climate and urban climate information based on grid and vector data. The information can be derived for different spatial and temporal scales depending on the aim and the demands. The Climate Mapping Tool can visualize most of the demanded urban climate data and data formats in combination with SkyHelios. All three models are linked together and can exchange relevant inputs and information.

### **KEY LESSONS LEARNED**

Equivalent temperatures are a possibility as a parameter for bioclimate assessments of thermal comfort, cold and heat stress.

The application possibilities of the models (RayMan and SkyHelios) cover several fields of human-biometeorology, including urban climate issues in the micro-scale.

Mitigation and adaptation possibilities based on human thermal comfort can be analyzed and quantified.

### **POLICY/PRACTICE IMPLICATIONS OF RESEARCH**

The concept of equivalent temperature based on the human-energy balance including air temperature, humidity, radiation, wind, clothing and activity, etc., provides clearer and more useful information that can be translated to policymakers and planners.

Long-term analysis of temperature, specifically the differences in physiological equivalent temperature, which is an indicator for the impacts of climate change on the thermal comfort of humans, can influence policymaking.

## KNOWLEDGE GAPS AND NEEDS

Cities in the era climate change require more information about microclimate conditions, as these form the urban climate.

Most studies currently focus on hotspot analysis, but long-term analyses are also needed.

How can we more effectively use data visualization and transfer to communicate the information to planners and architects?

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**Winston Chow** & Siti Nur Assyakirin Ali Akbar,  
National University Of Singapore, Kent Ridge,  
Singapore

*Influence of land cover on micro scale outdoor human thermal comfort in a tropical city*

### SUMMARY

Urbanization alters the physical environment over a multitude of spatial scales, with great implications towards human thermal comfort. Elevated temperatures arising from the urban heat island and from global climate change would likely increase thermal discomfort for urban residents. Despite this, the quantification of urban outdoor thermal comfort (OTC) presents a relatively new area of inquiry and knowledge, especially within cities located in the tropics, where research remains incipient. In this study, the influence of four land cover types on outdoor thermal comfort was examined through a combination of microclimatic sensor measurements and subjective surveys of park visitors that were obtained concurrently within a large urban park in Singapore. These types include: high-density vegetation, low-density vegetation, water body/feature and urban/built up area.

The study addressed the following questions: Do land cover variations matter with respect to OTC? Are perceived & objective OTC similar?

### KEY LESSONS LEARNED

Land cover does influence most microclimate OTC aspects significantly in terms of measured data but:

Subjective data do not show concordance;

Acclimation/acclimatization from duration of stay and other socio-cultural factors should be further investigated.

Influence of humidity and wind at urban microscales towards OTC should not be underplayed.

Existing heat indices developed under non-tropical regions may be inaccurate within tropical cities, especially when one considers subjective and perceived thermal comfort/discomfort by residents who may already be acclimatized to hot and humid conditions.

New indices may have to be developed specifically for cities located in these climates.

## KNOWLEDGE GAPS AND NEEDS

A lack of quantitative work exists on tropical urban thermal comfort work relative to other climates and other aspects of urban meteorology and climatology; future work in the context of this research includes:

Research into assessing or summarizing results from case studies would be very beneficial for a wide variety of stakeholders (academics, planners, landscape architects, etc.)

A future endeavor should include quantifying the complete ecosystem services provided by urban trees and vegetation for cities in these regions; this would require interdisciplinary contributions in terms of methodology and conceptual frameworks, in order for this expansion to develop.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Planners and design practitioners in humid tropical cities should be cognizant of the fact that land cover may not influence subjective or perceived changes to microclimate, possibly due to acclimatization from residents, when assessing the effectiveness of this ecosystem service provided by urban vegetation in this context; in particular, building design (micro) and precinct planning (local) should not neglect this, or worse, have contradicting design/planning outcomes.

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**Ariane Middel**, Shai Kaplan & Anthony Brazel,  
Arizona State University, Tempe, AZ, USA

Kathrin Hab, University of Kaiserslautern,  
Kaiserslautern, Germany

*Summer daytime oasis effect at the Las Vegas desert-urban fringe*

## SUMMARY

Previous research suggests that desert cities exhibit a daytime oasis effect, mainly driven by moisture availability and shading, which is the converse of the urban heat island effect at night. This study aimed to quantify the daytime oasis effect at the micro-scale level of a residential neighborhood at the Las Vegas desert-urban fringe. A typical development pattern along the northern extent of the city, adjacent to the Mojave Desert was chosen as the study site. The study highlights the importance of urban form, solar access and air flow in the creation of daytime oases for the hypothesis that the oasis effect does not decay uniformly, but has a complicated pattern dependent on local climate zones and landscape types.

## KEY LESSONS LEARNED

Desert-adapted shade trees have a strong potential to mitigate the urban heat island in xeric Phoenix residential neighborhoods; the cooling benefit is greater at the micro-scale (2.5°C) than at the local scale (1.1°C).

ENVI-met simulations suggest that adding trees to residential neighborhoods in Phoenix can reduce 2m air temperatures by 0.14°C per one percent increase in tree canopy cover on a mid-afternoon summer day; an increase in tree canopy cover from currently 10% to 25% in a Phoenix residential neighborhood resulted in an average daytime 2m air temperature reduction of up to 2.0°C at the local scale.

A distinct park cool island of up to 3.6°C was documented over a large park in Tempe, Arizona, consisting of irrigated turf and bare soil.

The park cool island effect can extend to non-vegetated surfaces.

Daytime heat in desert urban areas can be mitigated through vegetation and albedo modification of surfaces, but also by manipulating the form and spatial arrangement of urban features.

In mid-afternoon, dense urban forms can create local cool islands.

Intra-urban spatial differences in cooling are strongly related to solar radiation and local shading patterns.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Findings provide comprehensive design guidelines for practitioners to conduct environmental impact assessments of new developments.

Environmental assessment tools will become increasingly important, as more cities are developing climate action plans and working on mainstreaming climate considerations into housing developments.

A challenge will be to make the transition from sustainability science-infused municipal operations to private sector operations, which still dominate urban expansion in the US Southwest.

## KNOWLEDGE GAPS AND NEEDS

With regard to the ENVI-met simulations, further enhancement of the model is required to:

Better represent nighttime situations, including heat storage or materials; include variable wind speeds in a diurnal simulation; precipitation and irrigation parameters; and comprehensively represent anthropogenic heat (e.g., waste heat release from air-conditioning systems).

With regard to this study:

Support findings by in-situ measurements (transects from Las Vegas city fringe into desert); comparison of results to other desert cities; assessment of building energy performance; and, Economic assessment analysis of heat mitigation measures.



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**Hiroyuki Kusaka** & Asuka Suzuki-Parker, University Of Tsukuba, Tsukuba, Japan

Toshinori Aoyagi, Jma/Mri, Tsukuba, Japan

Sachiho A. Adachi, Riken/Aics, Tsukuba, Japan

Yoshiki Yamagata, Nies, Tsukuba, Japan

*Urban climate projection in Tokyo for the 2050's August by the 4-km horizontal grid spacing RCMs: Impact of RCM and urban scenario*

## SUMMARY

With a population of about 32.5 million, greater Tokyo is the world's largest metropolitan area. Summertime surface air temperatures have been trending upwards by 3.0 Kelvin over the last 100 years. Tokyo is already known for its exceedingly uncomfortable summers. In recent years, the number of deaths in Japan caused by heat stroke has been exceeding the deaths from other weather-related disasters including typhoons and tornados. Energy consumption due to an increased urban heat island effect has been a very serious problem since the 2011 Fukushima earthquake. Many citizens are concerned by the degradation of the urban environment and want to mitigate a worsening thermal environment. The influence of urban scenario work and their importance for future urban climate projections has not been sufficiently discussed. This study examined the influence of selected regional climate models (RCMs) and urban scenarios on urban climate projections (UCMs), using two different RCMs coupled with UCMs.

## KEY LESSONS LEARNED

The data distribution system with weather research and forecasting/urban canopy models from the Model for Interdisciplinary Research on Climate (MIROC5) under the RCP4.5 W scenario projected a temperature increase of 2.3°C.

The impact of the 'urban planning scenario' is about 0.3°C for Tokyo, which is comparable to the RCM difference.

The 'compact city scenario' reduces future warming in suburban areas. Considering the thermal environment, energy conservation and accessibility to the downtown area, the 'compact city scenario' is recommended.

Mitigating the heat spot at the building-scale (i.e., street level, road surface temperature) will be more effective than heat island mitigation at the urban-scale.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

The examination of the influence of selected regional climate models (RCMs) and urban scenarios on urban climate projections (UCMs) has important implications for mitigation policy targeted towards the future urban climate (micro-climate) in Tokyo and the urban heat island effect (meso-scale).

Tools such as the Global Warming Downscaler system web application allows non-specialists to do regional climate projections using a regional climate model; i.e., the simulated results consider impacts of urban planning, land use policy, greening policy and energy saving policy on the future regional climate.

## KNOWLEDGE GAPS AND NEEDS

Coupling RCM and computational fluid dynamics (CFD) models for microclimate projections.

Better climate data sets, as impact assessments and adaptation research utilizes future urban climate data created by climatologists.



# Session 79 Drivers and patterns of urbanization: Towards a typology

## SESSION ABSTRACT

The figures that describe urban areas reflect their importance in the 2<sup>1st</sup> century: urban areas are home to more than 50% of the world's population; generate more than 90% of the global economy; two-thirds of the world's energy is consumed by cities; and generate 70% of global greenhouse gas emissions. Current patterns of urbanization are significantly different from historical trends (Seto et al., 2010) and urbanization now drives global environmental change and presents challenges and opportunities for sustainability (Grimm et al., 2008). At the same time, global environmental changes such as a climate change and loss of ecosystem services present new challenges for urban sustainability.

Yet despite the global importance of urbanization as a process and urban areas as places, the science and policy communities have few empirical measures with which to compare urban places and urbanization processes. The most common metric to categorize, rank, and compare cities and urban areas is population size. Indeed, population size is the only urban metric that is available for nearly every city in the world. However, population size only reflects one characteristic of a city and is not consistently measured across cities or urban areas. For example, NYC is cataloged as 8 million and a variety of other sizes out to 22 million for the full metro area.

This session discussed the development of a typology of urban areas and urbanization that can be used to compare and contrast places and processes in the context of climate change; typologies must be sufficiently flexible in nature such that they can be used for other global change topics such as ecosystem services or sustainability assessments.

*Keywords: typology, urbanization*

## KEY DISCUSSION POINTS

The following are key areas or needs for future research. These include scale, data, and policy Relevance and their importance for understanding typologies:

Making use of information at different scales - typologies can be useful for policy and there is evidence of this at both global and national scales, but examples are limited.

Downscaling information from a high level and drilling it down to be useful at finer scales (i.e., making sense of what we know about the city at the county-level and making it relevant for neighborhoods).

Integrating the findings of life cycle analyses, ecological footprints, urban metabolism, etc., which have different strengths and units of analyses at various scales of focus, e.g., buildings, food chains, transportation, etc.

Overcoming the data challenge, as data is not always available for comprehensive typologies that would, for example, include connectivity, home-employment commute, walkability, all of which would provide richer insight into urban form and influence on emissions.

Including household behavior data and qualitative data (e.g., power relationships) need to be included in the analyses as well as underlying drivers such as policy and taxation which affect land use and hence, emissions.

Urban planners want the information typologies can bring, which includes benchmarks and the opportunity for comparisons with sister cities, but research findings must be communicated in ways that speak to the individual characteristics of the respective city.

## ORGANIZER

Karen Seto, Yale University, New Haven, CT, USA

## PRESENTATIONS

**Peilei Fan**, Jianguo Qi, Joseph Messina, Huiqing Huang & Xue Li, Michigan State University, East Lansing, MI, USA

Xi Chen, Chinese Academy of Sciences, Urumqi, China

Jiquan Chen, University of Toledo, Toledo, OH, USA

*Urbanization and environmental change in dryland east Asia: Patterns and drivers*

## SUMMARY

Large-scale urban developments have increasingly occurred in traditionally resource-limited and environmentally-vulnerable regions in developing countries, such as the arid zone in East Asia, resulting in serious environmental consequences. This research synthesized urbanization and environmental change in Dryland East Asia (DEA), defined as a region that includes Mongolia and four provinces in northwestern China (Inner Mongolia, Gansu, Ningxia and Xinjiang), from the 1990s to 2010. It compared the urbanization patterns and processes as well as the change of environmental conditions of several large urban areas in the region, including Ürümqi, Lanzhou, Yinchuan and Hohhot in Northwest China, and Ulaanbaatar in Mongolia. The presentation elucidated possible drivers that cause the specific patterns of urbanization and environmental changes seen in DEA cities.

## KEY LESSONS LEARNED

The selected cities have experienced extensive urbanization since the 1990s, as their urban land has expanded two-fold or more within two decades. Three trends have characterized urbanization in DEA: increases in urban land at the cost of other lands; typical land conversion pattern of grass land to

agricultural land to urban land; and, a trend to increase forestland, mainly through government intervention.

Impacts of urbanization on the environment of these cities are directly reflected by the loss of surrounding grazing and agriculture lands to urban built-up area, and the deterioration of soil, water and air quality over the past decades.

The cities experience four urban island phenomena: heat island, rain island, dry island and dark island. They are also vulnerable to water scarcity due to the temperate continental climate, with little rainfall and a high evaporation rate.

Three distinct socio-economic factors have played significant roles in the urban expansion and development in DEA including: economic growth, especially industrialization; institutional factors at multiple scales including the national development policy (e.g., the West China Development Program); and the urban land/property market in China as well as planning and development in Mongolia after the market reforms.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

With expected increases in the wealth and lifestyle changes of city residents and upgraded infrastructure that will facilitate further land conversion, aggravate air pollution and water shortages, policies must establish and enforce environmental laws and regulations on industrial water and air pollution discharges; plan compact cities and walkable communities to discourage automobile usage; advocate for water-efficiency technologies and recycling for agriculture and industries; and educate the public on low-carbon life styles environmental sustainability.

Because of the unique historic, ethnic and cultural characteristics of these cities in DEA, the Chinese government's ability to effectively build relationships in Xinjiang and other regions of the Northwest, either through economic development, migration strategies, policy incentives or a combination of all three measures, will be critical to the sustainability of these cities.

## KNOWLEDGE GAPS AND NEEDS

More integrated and quantitative studies of these cities and their respective regions on a longer temporal scale (such as 1960 - 2010) utilizing different models and a variety of data sources, such as satellite images, economic statistics, population, environment and pollution statistics while focusing on the linkages between urbanization, environmental change, economic development and policy interventions.

Utilizing historical documents and local government archives in China and Mongolia to examine the changes of the 20<sup>th</sup> century (or an even longer period), in order to understand the coupling and co-evolution of human and natural systems on a longer time horizon with urban change.

Simulations of future socio-economic development patterns and climate change scenarios based on this data and knowledge integration.

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**Felix Creutzig**, Mercator Research Institute on Global Commons And Climate Change, Berlin, Germany

Giovanni Baiocchi, University Of Maryland, College Park, MD, USA

Robert Bierkandt & Paul Pichler, Potsdam Institute For Climate Impact Research, Potsdam, Germany

Karen C. Seto, Yale University, New Haven, CT, USA

*A global typology of urban energy use and implications for climate change mitigations*

## SUMMARY

The aggregate potential for urban mitigation of global climate change is insufficiently understood. This analysis used a dataset of 274 cities representing all city sizes and regions worldwide, demonstrating that economic activity, transport costs, geographic factors and urban form explain 37% of urban direct energy use and 88% of urban transport energy use. The research highlights the significant potential of reducing energy use in rapidly urbanizing Asia, Africa and the Middle East.

## KEY LESSONS LEARNED

Of the 15 types of cities classified, the most important classification variable is population density – cities that are above 50 people per hectare exhibit different human behaviors with respect to emissions than those below this density.

Lowest emission types have characteristics which include: high density and a small household size; high density, higher household size, low income and also low heating degree days (climate variable).

Highest emission types include characteristics of low population density and high income, but with little influence from housing conditions.

London is a very unique case with respect to the rest of England, as it has both the lowest and highest emissions types; low emission types are found to be more within the center of the city (high pop density); highest emissions are located in the outer fringe.

If current trends in urban expansion continue, urban energy use will increase more than three-fold from 240 exajoules (EJ) in 2005 to 730 EJ in 2050.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

The model shows that urban planning and transport policies can limit the future increase in urban energy use to 540 EJ in 2050 and contribute to mitigating climate change.

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**Subhrajit Guhathakurta** & Wenwen Zhang, Georgia Institute Of Technology, Atlanta, GA, USA

Eric Williams, Rochester Institute Of Technology, Rochester, NY, USA

*The impact of neighborhood urban form on household energy use: A case study of Phoenix, Arizona, USA*

## SUMMARY

Urban form, land use patterns and structures in the built environment significantly influence a city's energy needs, and consequently, its greenhouse gas (GHG) emissions. Engineering and design of urban

form is an important strategy for managing climate change and other environmental impacts of energy as well as being key to the livability of cities. This study clarifies connections between urban form and its use together with the associated energy demands for infrastructure (buildings and paved surfaces) and transportation. The model is tested through case studies of two Phoenix sub-areas, one in downtown Phoenix, which is undergoing redevelopment towards higher density housing and the second, a low-density suburban area at the edge of Phoenix, which has undergone significant growth in the last two decades.

### KEY LESSONS LEARNED

Energy efficient buildings do not necessarily lead to higher energy efficiency at the neighborhood scale.

A complete evaluation of all energy use related to neighborhood characteristics suggests that road infrastructure and travel behavior often overwhelm the energy gains from more energy efficient buildings that may be constructed.

Very high-density buildings that are high-rise and use concrete and steel will have higher energy intensity embedded in the materials and in energy used in construction. Hence, while increasing density of buildings does help in reducing energy used, the overall urban form has a significant impact, specifically in terms of the design of roads and the profile of buildings.

### POLICY/PRACTICE IMPLICATIONS OF RESEARCH

These findings have clear implications for urban policies – specifically policies that provide guidance for planning urban neighborhoods:

Urban development policies should not just focus on one aspect, such as density, but should also contain specific guidelines for ensuring that overall form and transport infrastructure also help in limiting energy use.

The most pertinent area of regulations that would affect the energy profile of neighborhoods is subdivision regulations; the guidelines on layout of

new subdivisions, their plot densities and the network of streets can be significant in reducing urban energy use.

There are already guidelines and incentives in place for reducing building energy, such as through Leadership in Energy Efficient Design (LEED) certification.

Recognizing the importance of neighborhood design, LEED for neighborhood development (LEED-ND) is now being vetted and pilot tested for implementation.

The research provides a methodology for measuring neighborhood energy demands and offers a quantitative basis for making policy decisions.

Policies aimed at increasing residential density and at regulating the building typology should be part of broader energy conservation and GHG emissions reduction policies at the state and federal level.

### KNOWLEDGE GAPS AND NEEDS

Few studies have been able to determine the extent to which people's behavior is based on their attitudes and cultural traits compared to the environmental context. This particular methodological inadequacy is known as the 'self-selection' bias; although our measures are able to detect changes in behavior based on the environmental context, the population studied might be especially inclined to such behavior based on their attitudes. More sophisticated tests and longitudinal data are needed to address such biases.

Introducing energy efficiency in one aspect of lifestyle can lead to a 'rebound effect' on a different aspect, which often reduces the benefits of the first intervention, e.g., those who buy energy efficient cars might be more inclined to drive more often (or buy other energy intensive items) since their disposable revenues have now increased; good estimates of the extent of such rebound effect is extremely difficult.

The complete portfolio of energy use in a neighborhood, which includes embedded energy in materials, operational energy, and energy used in travel must be further evaluated.

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Thomas Crawford, Saint Louis University, St. Louis, MO, USA

*Urban form as a technological driver of carbon dioxide emissions: A structural human ecology analysis of on-road and residential sectors in the conterminous U.S.*

## SUMMARY

This research integrated themes from GIScience, land change science and structural human ecology to investigate the influences of urban form on U.S. CO<sub>2</sub> emissions in the on-road and residential sectors. The STIRPAT human structural ecology paradigm was extended by theorizing urban form as a socio-technical system to be included as a technological driver within frameworks seeking to understand CO<sub>2</sub> emissions. County-level 2002 emissions data were assembled from the Project Vulcan dataset. A remote sensing classification product was used to quantify spatial composition measures of urban form for 3,108 conterminous U.S. counties. Spatial error regression models were estimated that alternately insert variables measuring population and developed area. This strategy enabled new interpretations of the effects of population, affluence and urban form. Implications are that a focus on urban form provides policymakers greater leverage for carbon mitigation compared to the structural human ecology's traditional focus on population and affluence. However, the effects of urban form must be tempered by recognition of their modest quantitative magnitude compared to the much larger effects made possible by transition to cleaner energy sources and less consumptive human behaviors.

## KEY LESSONS LEARNED

Results confirm prior findings for the effects of population and density and original results suggesting urban heat island effects for residential emissions and carbon reduction benefits achievable through a developed land use mix containing a greater proportion of high-intensity relative to low-intensity land use.

Urban form matters, but it matters differently in terms of sign, significance and interpretation depending on emissions sector and metro versus non-metro status.

Models show demonstrable reductions in emissions associated with greater density and greater share of land use in the higher intensity class.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Assuming that income effects are positive in all cases, positive population and income effects provide limited avenues for mitigation strategies. However, policymakers in U.S. counties and municipalities therein desire strategies that promote economic growth. Growth entails an increase in population due to new jobs and associated multiplier effects. While increased income is certainly desirable, it has the undesirable effect of increasing emissions.

Focusing on the most basic STIRPAT variables of population and affluence seems to limit options to either a no growth or slow growth agenda; shifting focus to strategies beyond these most basic variables offers a more expanded set of strategies.

Behavioral modification and clean technology development are two strategies with greater potential, but difficulties exist related to challenges in behavior modification and the longer time horizons associated with transition to cleaner energy sources.

Stronger consideration of developed land use patterns has the potential to give actors in this socio-technical system greater leverage to enact mitigation strategies. However, the effects of urban form must be tempered by recognition of their modest quantitative magnitude compared to the much larger effects made possible by transition to cleaner energy sources and less consumptive human behaviors.

## KNOWLEDGE GAPS AND NEEDS

More work involving mixed methodologies to investigate urban form as a technological driver of CO<sub>2</sub> emissions is needed.

There is a need to assess the degree to which practices and knowledge of actors in the urban and regional planning profession reflect connections between urban form and emissions. Interviews and surveys of these professionals can elucidate these connections.

Content analysis of local, state and regional policy documents (i.e., climate action plans) is needed to assess the degree to which urban form as a mitigation strategy enters the policy arena.

There is spatial variation in the strength of urban form as a driver of emissions. Quantitative modeling using spatial techniques, such as geographically weighted regression, are needed to understand this variation.

The role of urban form and urban heat island effects must be studied in more depth, i.e., heat island effects are typically viewed as a bad thing to be mitigated, however, heat islands may have the opposite effect in winter by increasing temperatures and thus contributing to less fossil fuel consumption for home heating.

What are the net effects of heat islands on CO<sub>2</sub> emissions? How do net effects vary geographically by climate type?

Improvements in spatially explicit emissions data are needed and better evaluation of uncertainty is paramount.

Temporally explicit data are also needed at fine spatial scales (counties or gridded products), in order to more formally model change as opposed to cross-sectional analysis for a single year.

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**Weifeng Li**, University of Hong Kong, Hong Kong, China

Jiansheng Wu & Qian Lin, Peking University - Shenzhen Graduate School, Shenzhen, China

*Vegetation cover dynamics associated with rapid urbanization in China's metropolitan areas (1998-2010)*

## SUMMARY

How vegetation cover has been affected by different urbanization trajectories in China's major metropolitan areas has rarely been studied. In this research, DMSP/OLS night-time light time series images and SPOT-VGT satellite-derived Normalized Difference Vegetation Index (NDVI) was used to evaluate effects of urbanization on vegetation cover in the six major metropolitan areas (urban agglomerations) in East China over the last decade. Urbanization dynamics at regional scales were mapped with the night-time light data and used to identify different urbanization trajectories based on the temporal signatures. The NDVI were then added to study the characteristics and change of vegetation cover in the areas with different urbanization trajectories.

## KEY LESSONS LEARNED

Vegetation cover decreases with an increase in level of urbanization.

If compared to the average change rate of NDVI in the non-urban areas (which in fact showed an improvement trend in all the six regions), the results indicate a negative average change in vegetation cover in all of the selected metropolitan areas.

The decreasing rate accelerated at the early stage of urbanization and recovered in the later stage of urbanization; the peak value appears in different stages across different regions.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Different patterns of NDVI changes are closely linked with policy-oriented differences in urbanization dynamics of these regions.

Implementing a sustainable regional growth policy is key.

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**Ayyoob Sharifi**, Global Carbon Project, Tsukuba, Japan

Yoshihio Chiba & Kohei Okamoto, Nagoya University, Nagoya, Japan



*Urbanization and landscape change in a newly developing country: The case of Vientiane, Laos*

## **SUMMARY**

While many countries around the world are experiencing declining rates of urbanization within the past three decades, Laos has witnessed a significant increase in its urban population. This started in 1986 when the country began its transition to a market economy. Urbanization in the neighboring countries has been examined extensively in the literature. However, only very few researchers have addressed this issue in the Laotian context. To fill this lacuna in research, the urbanization pattern in Vientiane, the capital of Laos was surveyed. This study focused on both physical and non-physical aspects of Vientiane's urbanization.

## **KEY LESSONS LEARNED**

Urban growth in Vientiane has evolved into a sprawl pattern resulting in a loss of many invaluable natural resources.

Fragmented governance exists and there is a lack of integrated land management.

Master planning has failed to control and regulate urban growth in Vientiane.

Lack of legal basis, rigidity of zoning, exclusion of local authorities and non-participatory processes prevail.

## **POLICY/PRACTICE IMPLICATIONS OF RESEARCH**

This study may help decisionmakers make more informed choices for urban development.

Results indicate that there is an urgent need for improvements in regulatory and management aspects.

The master plan should be revised and updated to provide a more realistic account of the existing situation.

## **KNOWLEDGE GAPS AND NEEDS**

There is a need to reorient master planning toward strategic spatial planning with the following components:

A selective approach that acknowledges limitations, e.g., budgetary limitations, to solve select issues;

Attention to non-physical aspects of planning, i.e., less rigid than typical master planning;

An integrated network of vertical and horizontal relationships to address governance fragmentation;

Revisions and updates are necessary to address the dynamism of cities as socio-ecological systems;

Involvement of multiple stakeholders; and,

Strong linkages to implementation and mechanisms for management.

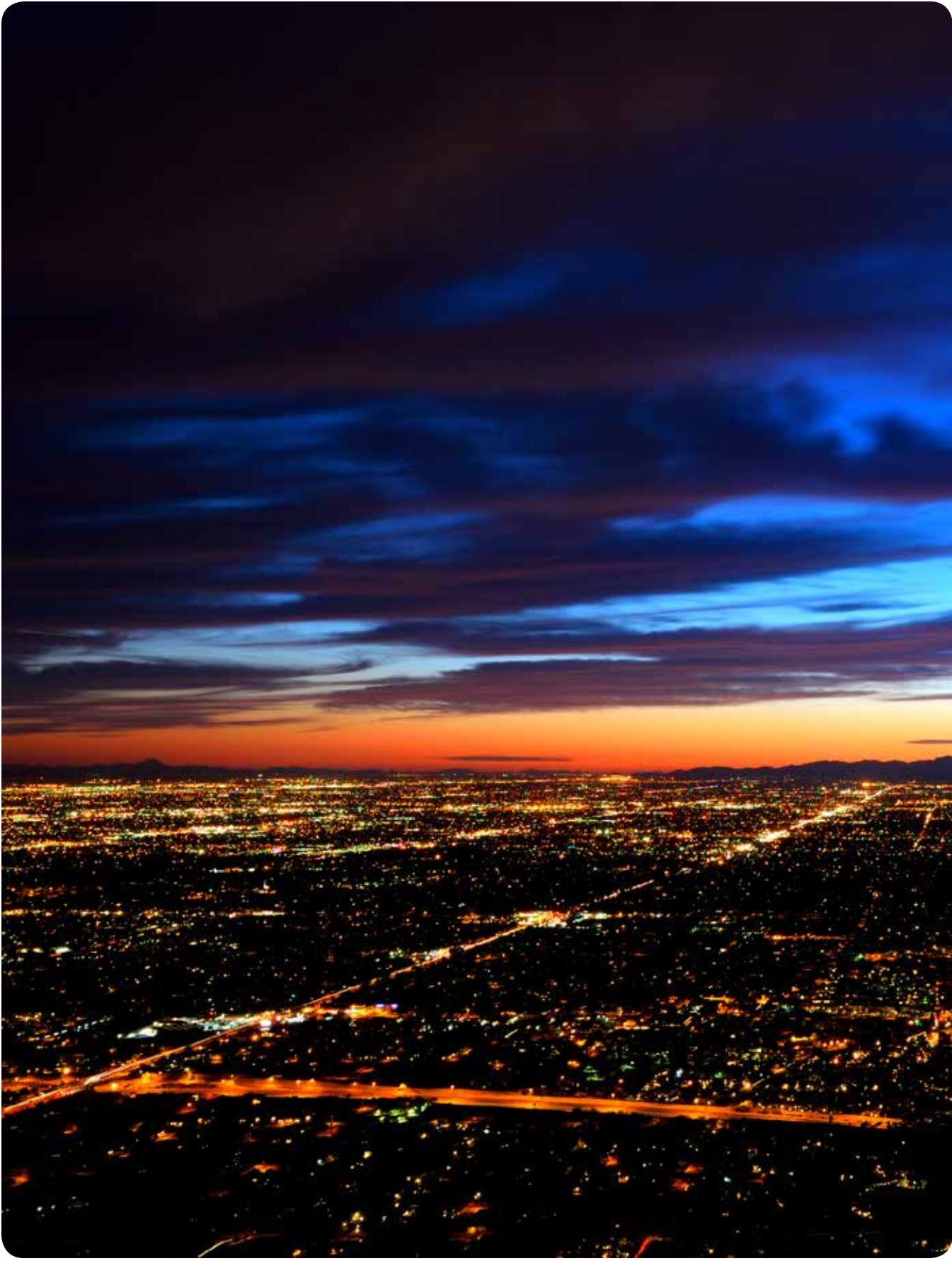


# Theme 2 Urban Responses to Climate Change: Adaptation, Mitigation and Transformations

The urban statistics are familiar to many - urban areas generate more than 90% of the global economy; are home to more than 52% of the world population; consume more than half of the world's energy; and emit approximately three-quarters of global greenhouse gas emissions. The world is projected to become more urbanized and many developing countries, in particular India and China, will experience very rapid urbanization and environmental change. It is within the cities that the impacts of these changes are felt, but also where action is taken (whether it's mitigation, adaptation or sustainable development policies and governance responses), and where great potential for intervention of urbanization trajectories exists towards creating more livable urban futures.

Despite the fact that cities are at the forefront of climate change adaptation and mitigation responses, local actions to address climate change are moving faster than our capacity to understand the effectiveness, benefits and unintended negative consequences of those actions. Theme 2 highlights the critical need to go beyond descriptive case studies or calls for further urban responses to climate change, and to take a more analytical approach to understanding the diversity of responses that exist, the lessons to be learned from them, the implications for city-level policies, development and what cumulative effect this might have at the regional or global scale. This implies looking critically at existing and newly developing governance structures and institutions by investigating the motivations behind the efforts to govern climate change, strategies and differing institutional capacities amongst cities.

The sessions within this theme synthesized what we have learned regarding the responses that take place within the urban system focusing on questions such as: What are the linkages that exist between adaptation, disaster risk reduction and resilience? What factors influence policies for urban climate change adaptation (e.g., differences between the North and South, cities of varying levels of development, political contexts, etc.)?; What makes effective strategies, effective, i.e., are there certain institutional/governance structures which need to be in place that are key for transformation? Sessions that offered perspectives from the physical sciences were equally important, for example, through the sharing knowledge of urban footprints (increasing or decreasing emissions) and cities' actual effectiveness to reduce health impacts from heat waves and air pollution.



# Session 14 Human dimensions of urban heat islands

## SESSION ABSTRACT

Extreme heat events are among the leading weather-related causes of illness and death in cities across the globe. Continued urbanization will place more people in microclimates modified by the built environment; often temperatures in these settings are higher because of the urban heat island effect. This trend, combined with the threat of a warmer future and an increasingly aging population, makes it possible that heat-related health risks will increase in the future. Public officials are beginning to make investments in various intervention strategies to minimize the health burden associated with extreme heat events.

This session featured research examining the effects of heat within urban areas. The spatial and temporal dimensions of heat-related health risks within cities are only beginning to be fully understood. Challenges facing the research community include: spatial variation in mortality and morbidity associated with extreme heat; intra-seasonal variability (of health outcomes, climate conditions or extreme heat events); the relative impact of social versus environmental factors in contributing to vulnerability; short- and long-population acclimatization; identification of optimal exposure variables; identification of optimal outcome variables (total deaths, years of life lost, displacement-adjusted mortality, etc.); evaluating the effectiveness of intervention strategies including heat warning systems; the contribution of indoor versus outdoor exposure to risk; and quantifying, qualifying, or responding to heat vulnerability.

*Keywords: extreme heat, health, urban, risk, climate change, urban heat island*

## KEY DISCUSSION POINTS

The content of the studies presented work well in North American and European cities, where there is a wealth of information and data. However, the majority

of future urban growth will occur in Asia and Africa, where there are serious issues with the availability and quality of data. Such issues cannot be resolved easily. Are the methodologies of these studies easily transferable to an Asian context? Logistical issues and the lack of cooperation and data make obtaining results very difficult.

Crowd sourcing as a source of local data, especially the use of cellphones and online technology to take measurements of local climate, is an important tool for future research. Local data collection can be problematic, both in terms of the cost of the data (remote sensing images and the monitoring devices themselves) and being able to handle the collection devices without incident.

Cities need to do a better job of incorporating urban heat island (UHI) into policy decisions regarding the development of urban form. Every city is unique and local research is key to developing strategies for dealing with UHI, especially in locations where UHI can be severe, e.g., Phoenix, AZ, USA.

## ORGANIZERS

Wen-Ching Chuang - Arizona State University, Tempe, AZ, USA

David Hondula - Arizona State University, Tempe, AZ, USA

Matthias Ruth - Northeastern University, Boston, MA, USA

## PRESENTATIONS

**Felix Creutzig** & Blanca Fernandez, Mercator Research Institute on Global Commons and Climate Change, Berlin, Germany

## SUMMARY

Climate change impacts are diverse and highly uncertain, but could possibly impact the livelihoods of large parts of humanity. As Earth transitions to a mostly urban planet, the question of how climate risks impact urban populations becomes more prevalent. A main risk of climate change, global warming, translates into urban heat risks and impacts urban populations.

Provided is a meta-analysis of case studies on urban heat risks and equity (Fernandez Milan and Creutzig, 2015). Person-specific, intrinsic factors dominate overall heat risks, but socio-economic characteristics can dominate, particularly in urban contexts. Higher age and to a lesser degree, gender, are the most important demographic variables determining heat-related health risk.

## KEY LESSONS LEARNED

Heat waves negatively affect human health, especially urban populations.

Intrinsic (e.g., age, gender, medical status) and extrinsic (e.g., socio-economic status, employment, quantity of green space, building types) factors determine vulnerability to heat waves.

Short-term mitigation response measures effectively address intrinsic factors, but these strategies do not exhaustively address extrinsic factors, which then raises issues of equity.

Long term mitigation strategies are plausible in addressing equity in terms of socio-economic susceptibility to urban heat waves.

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**Onur Özgün & Matthias Ruth**, Northeastern University, Boston, MA, USA

*Modeling the feedbacks between socio-economic changes and urban heat island (UHI)*

## SUMMARY

Although at first glance, the urban heat island

problem seems static in time and linear in the sense that causes are independent of effects, important feedback mechanisms exist over the long-term, resulting in urban temperatures rising faster than rural temperatures. For instance, the persistent temperature increase in cities increases air conditioner ownership, contributing to anthropogenic heat - a major cause of urban heat islands.

System dynamics - a modeling and simulation methodology for the study of complex dynamic systems - was used to analyze how the interaction of natural, social and political processes in the city creates an increasingly pronounced urban heat island. With an established base of knowledge, the causal relationship between system variables were defined, and the feedback loops that create behavior over time were identified.

## KNOWLEDGE GAPS AND NEEDS

There is a need for a simple, yet accurate parameterization of UHI intensity based on physical characteristics and further modeling of the effects of UHI mitigation measures.

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Wen-Ching Chuang, Arizona State University, Tempe, AZ, USA

*Critical perspectives on vulnerability assessment: case studies of heat stress in Phoenix, AZ*

## SUMMARY

The impacts of climate effects and environmental change are increasingly examined through the lens of vulnerability. However, vulnerability assessments remain challenging due to the lack of measurement guidelines of 'vulnerability' in current theoretical frameworks. Empirical analyses examined the limitations of two methods widely used for vulnerability assessment: vulnerability index and vulnerability mapping.

## POLICY/PRACTICE IMPLICATIONS

Cities must incorporate place-based factors to increase the usefulness of vulnerability indices.

It is important to communicate to decisionmakers that these indicators and assessments are very sensitive to scale, measurement and context, and that using multiple data sets is important for good decision making and the development of effective intervention policies.

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**David Hondula**, Matei Georgescu, & Robert Balling Jr., Arizona State University, Tempe, AZ, USA

*Challenges associated with projecting urbanization-induced heat-related mortality*

### SUMMARY

The aim of this study was to quantify the number of excess deaths attributable to heat in Maricopa County [Arizona, USA] based on three future urbanization and adaptation scenarios and multiple exposure variables. Two scenarios (low and high growth projections) represent the maximum possible uncertainty range associated with urbanization in central Arizona, and a third represents the adaptation of high-albedo cool roof technology.

Subject to the urbanization scenario and exposure variable utilized, projections of heat-related mortality ranged from a decrease of 46 deaths per year (-95%) to an increase of 339 deaths per year (+359%). Projections based on minimum temperature showed the greatest increase for all expansion and adaptation scenarios and were substantially higher than those for daily mean temperature. Projections based on maximum temperature were largely associated with declining mortality. Low-growth and adaptation scenarios led to the smallest increase in predicted heat-related mortality based on mean temperature projections. Use of only one exposure variable to project future heat-related deaths may therefore be misrepresentative in terms of direction of change and magnitude of effects.

### KEY LESSONS LEARNED

The preference for low growth or urban adaptation strategies depends on key exposure variables.

Urbanization may contribute to future changes in heat-related mortality.

Scenario projections are highly sensitive to level of urbanization and exposure variable choice.

An urban 'oasis' effect emerges in arid and semi-arid climates in which daytime temperatures are often lower in the city center than in the surrounding dry landscape. Urban heating thus primarily concerns minimum/overnight temperatures.

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**Aaron Hardin** & Jennifer Vanos, Texas Tech University, Lubbock, TX, USA

*Assessment of localized urban climates and associations with air pollution and synoptic weather patterns*

### SUMMARY

The synergistic biophysical systems within urban areas can result in substantive negative societal and health consequences due to the hazards of extreme temperatures and ambient air pollution. In order for cities to manage the growing risks and vulnerability of such exposures, progress in understanding the spatial and temporal variations in urban heat island (UHI) development is critical.

This current study aimed to address the multidimensional issues of these hazards on health, science and society. The formation of the UHI was studied under various synoptic-based air mass types to determine differential spatial and temporal development and intensities of the surface UHI.

### KEY LESSONS LEARNED

Heat is only one of many factors that should be considered for UHI studies; air pollution, among others, should also be included.

The largest UHI occurs when a dry weather type is present both during the day and at night.

Dry tropical (DT) synoptic weather has the hottest UHI in urban areas, with moist tropical plus (MT+) being the hottest over the entire area.

## **POLICY/PRACTICE IMPLICATIONS OF RESEARCH**

Once a specific area of a city has been found to have the greatest warming caused by the UHI, mitigation strategies should be developed to help address the urban risks and hazards associated with the area (e.g., cooling center locations, targeted heat warnings, emergency responders, etc.)

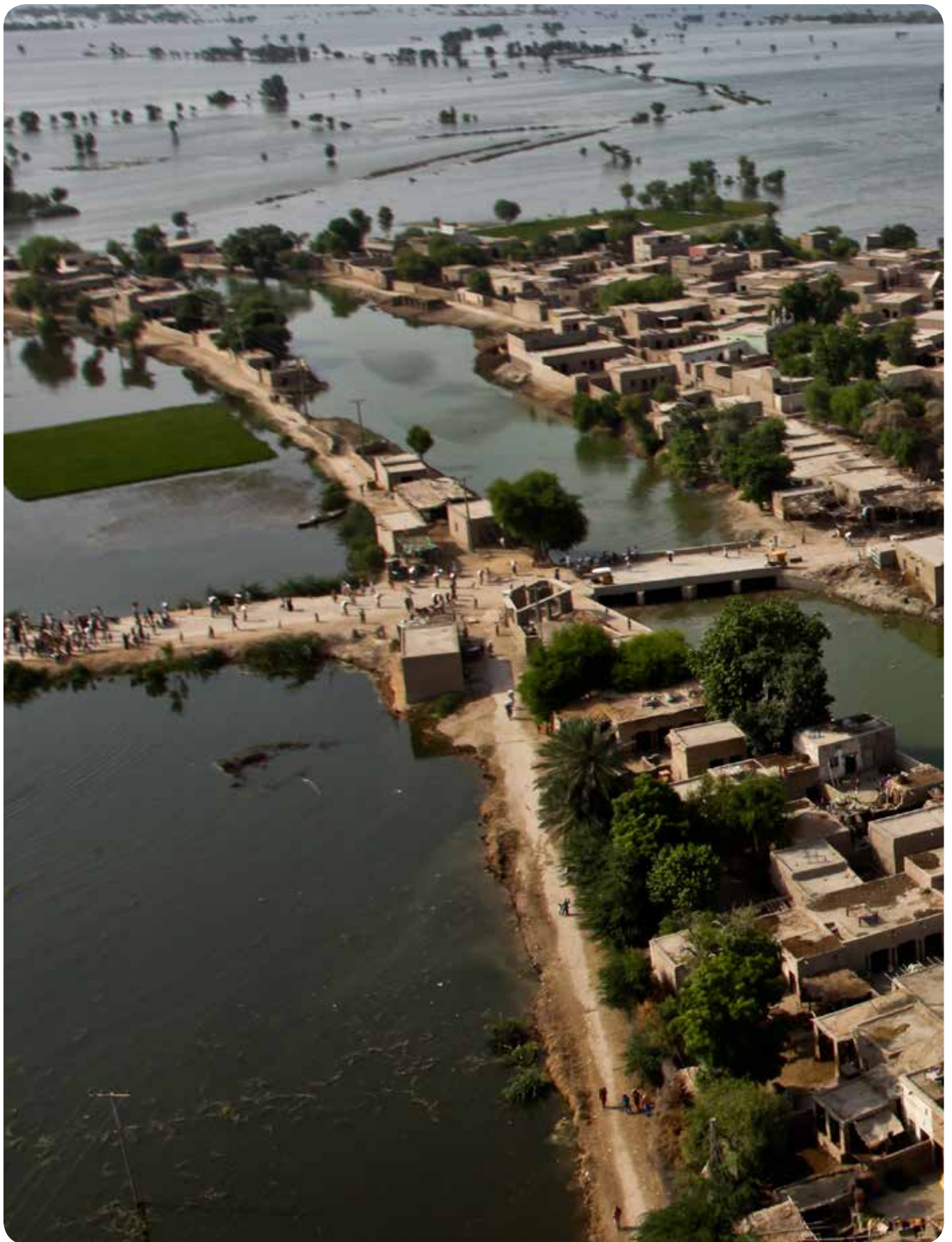
## **KNOWLEDGE GAPS AND NEEDS**

Urban climate research requires a standardized procedure for determining nighttime and daytime UHI as well as a standard methodology for calculating the UHI. Local Climate Zones could standardize surfaces that are often delineated as 'urban' or 'rural'.

Neighborhood-scale 'UrbaNet' weather station data collected by NOAA and Earth Networks has the potential to consider other meteorological variables (e.g., wind and humidity) in further analyses.

UrbaNet data, combined with air pollution sensors, can support the creation of more localized forecasts by operational meteorologists.





# Session 16 Building resilience in Asian cities

## SESSION ABSTRACT

Strategies for adapting to climate change from different sectors have a spatial dimension due largely to the geographic variation of land use activity and urbanization. This, in turn, has meant that these strategies were to be implemented at local levels. Immediately after the adoption of the Adaptation Strategies to Climate Change in Taiwan by the Executive Yuan of Taiwan in 2012, the Council for Economic Planning and Development (CEPD) initiated pilot studies of local adaptation plans for two municipalities and published the Planning Guidelines for Local Adaptation Plans to direct other municipalities' adaptation plans. The Guidelines incorporated a strategic planning process to reflect a broad-based consensus among stakeholders and targeted cross-sectorial co-benefits. Currently, twelve municipalities in Taiwan have already finished their climate change adaptation plans.

This session reflected on and took stock of the ongoing initiatives across Asian cities. The session gave specific attention to adaptation strategies in Taiwan to build climate resilience, the ways these have been informed by scientific research, and their potential for sustained and transformative outcomes. Emphasis was placed on the role of research in informing neighborhood- and city-level actions and shaping policy. The session focused on the lessons learned from the involvement of local adaptation plans while also addressing concerns of the effectiveness of multi-level governance in different municipalities - through partnerships among stakeholders, multi-level agencies and planning teams - to empower capacity building for local adaptation strategies. The panelists provided examples of how locally acceptable responses can be developed. The discussion thereafter enabled reflection and knowledge exchange on the implications for building

future urban resilience in the Asian context including the role of research in this endeavor.

*Keywords: local adaptation plan, multi-level governance, strategic planning process, Taiwan, Asia, urban resilience, research, policy*

## KEY DISCUSSION POINTS

Involvement of multiple stakeholders including the private sector, local residents and community groups is essential for the success of climate change adaptation planning. However, it must be done with great care and with attention to detail, including local variations in culture and preferences for development. Building these relationships takes effort, but is well worth the time, as it increases the chances of success.

In order to be successful, climate change adaptation plans need mechanisms for monitoring and evaluation.

Disaster risk management and climate change adaptation share many characteristics and should be reconciled, in order to increase the effectiveness of their implementation.

## ORGANIZERS

Diane Archer - International Institute for Environment and Development, London, UK

Shu-Li Huang - National Taipei University, Taipei, Taiwan

## PRESENTATIONS

Fie-Yu Kuo, National Development Council, Taipei Taiwan

*National climate change adaptation policy and initiatives of the local adaptation plan for Taiwan*

## SUMMARY

After the adoption of the Adaptation Strategies to Climate Change in Taiwan by the Executive Yuan of Taiwan in 2012, the National Development Council initiated pilot studies of local adaptation plan development and implementation for two municipalities. The Planning Guidelines for Local Adaptation Plans was also drafted to direct other municipalities in their own adaptation planning efforts.

Currently, seventeen municipalities in Taiwan have received financial support from the National Development Council and have already finished their adaptation plans under the supervision of an expert team. At present, the national government of Taiwan is preparing for the second stage, promoting the implementation of action plans for climate change adaptation within local governments.

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Chia-Tsung Yeh, National Taipei University, New Taipei City, Taiwan

*Framework and procedure of the local climate change adaptation planning in Taiwan*

## SUMMARY

In 2012, the executive branch of Taiwan, also known as the Executive Yuan, established the 'National Adaptation Strategy to Climate Change in Taiwan' as guidance for national-level climate change adaptation in Taiwan. Meanwhile, the design and planning of local adaptation strategies began to take place across Taiwan's cities. The working framework of local adaptation planning includes the central government, local government, local planning team, expert consortium and local committee members. Incorporating the recommended processes of the UNDP's Adaptation Policy Framework with the concept of strategic planning, a five step procedure was designed for local adaptation planning: (1) analyzing the socio-economic environment and impacts of future climate change; (2) determining the key sectors of adaption; (3) assessing local vulnerability under the impacts of climate change; (4)

formulating adaptation strategies; and, (5) designing the short-term and long-term action plans.

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Hung-Ping Huang, Taoyuan County, Taiwan

*Experience of planning local climate change adaptation plan: Lessons and expectations*

## SUMMARY

In 2013, with the support from the National Development Council of Taoyuan County, the city initiated the formation of its local climate change adaptation plan. A committee was established that included all departmental directors and various experts from Taoyuan universities, in order to administer the planning effort. This committee was chaired by the Taiwan Deputy Mayor.

The Environmental Protection Administration has also created a mitigation program to promote low carbon cities in Taoyuan. It has been suggested that the local government should integrate various initiatives from the central government, in order to cope with climate change issues efficiently and effectively.

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**Bach Tan Sinh** & Quynh Anh Nguyen, National Institute For Science And Technology, Hanoi, Vietnam

*Multi-level governance in building urban climate change resilience in Vietnam: Experience from the Asian Cities Climate Change Resilience Network of Vietnam*

## SUMMARY

Three cities in Vietnam are used as case studies to examine (from a governance perspective) the dynamic and innovative process of engaging stakeholders at various levels in building the city's urban climate change resilience capacity. For the first time, a community of practitioners has shared their vision, ideas and new approaches on how to address future climate change impacts in cities, which are growing rapidly. A number of informal networks and relationships have been built through innovative ways of engaging various stakeholders, such as the shared learning dialogue (SLD) - a new approach to planning

that better facilitates the participation of concerned stakeholders.

### KEY LESSONS LEARNED

Building partnerships and trust takes time and effort; it is the most important challenge of the planning process. Once trust is established, one can create an enabling environment that ensures that all other measures can be implemented.

The person who leads the project should have the capacity to bring different stakeholders to the table.

The framing of a message is important; it needs to be action-oriented and framed around issues that the local community is already experiencing.

Providing a learning platform and being able to share experiences among practitioners and planners can enhance the social learning among partners.

Social scientists have a role in helping to communicate the impacts of climate change with local stakeholders.

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**Shiraz Wajih** & Nivedita Mani, Gorakhpur  
Environmental Action Group, Gorakhpur, India

*Influencing policies for community-driven urban climate change resilience: The case of Gorakhpur, India.*

### SUMMARY

Gorakhpur, a secondary city, is among the fastest growing cities in the mid-Gangetic plains of India. Its proximity to the Himalayas makes it vulnerable to floods, which cause huge losses to lives, assets and resources. This is exacerbated by climate uncertainties, adversely impacting the livelihoods of poor and marginalized communities. The city's urban planning and development mechanisms generally neglect the needs and priorities of communities living in informal fragile settlements, which are particularly vulnerable to climate change impacts. In order to address this, processes of vulnerability analysis and resilience strategy development at neighborhood, ward and city levels involved marginalized communities, concerned citizens, elected representatives, government officials and media. This helped to identify priority sectors

impacted by climate change for initiating actions. Key policies and regulatory provisions were identified for the selected sectors, such as solid waste, drainage, drinking water, urban planning, housing, energy, ecosystems and public health.

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Rukuh Setiadi, Griffith University, Gold Coast,  
Australia

*Addressing global environmental change in two Indonesian cities: Policy change and path dependency*

### SUMMARY

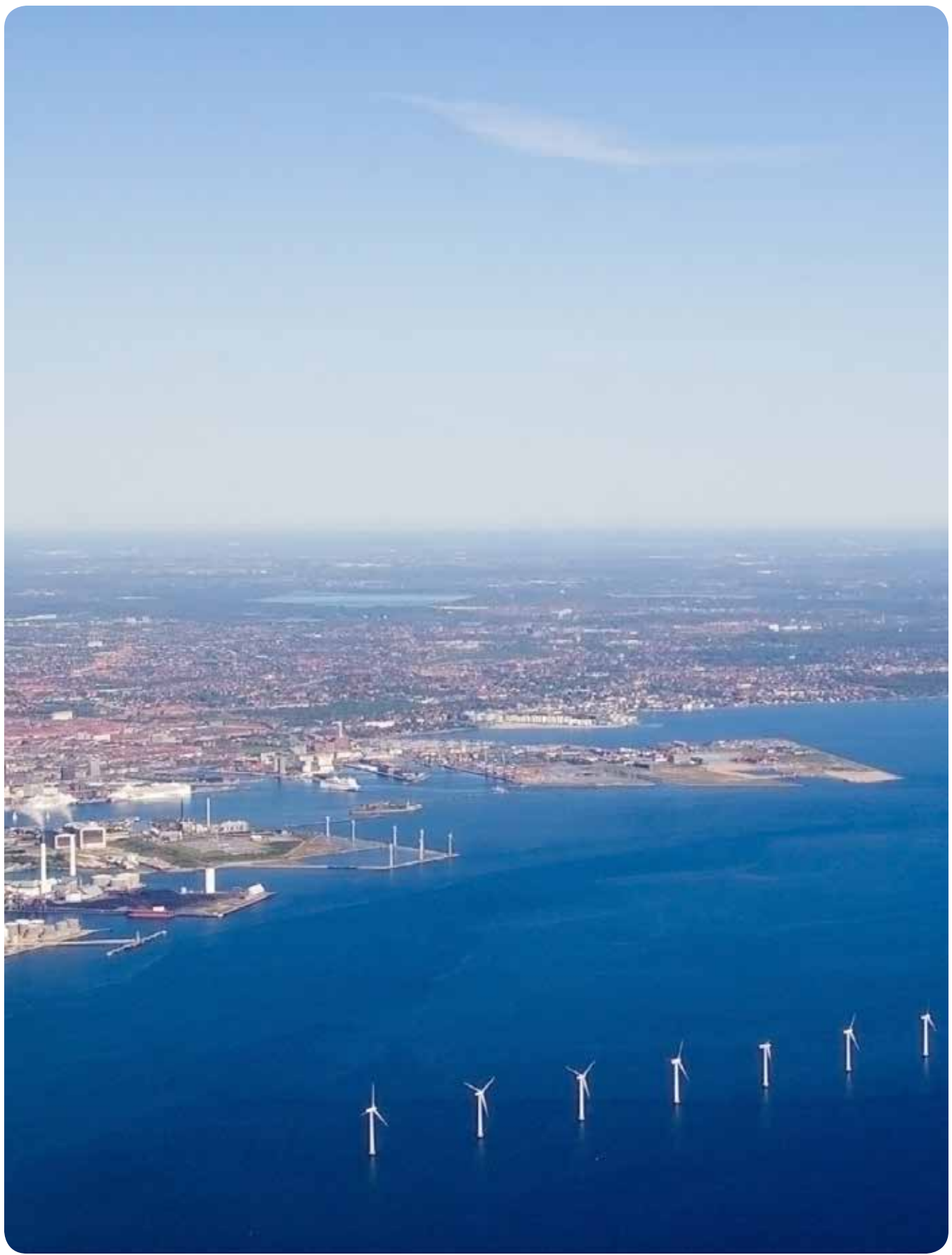
Significant changes in policy orientation regarding climate change adaptation are evident in the cities of Pekalongan and Semarang, Indonesia, although they demonstrate contrasting policy directions. The extent to which these policy orientation changes overcome structural barriers to local adaptation in practice was the focus of this study.

### KEY LESSONS LEARNED

Results reveal that the changes in policy orientation in the city of Pekalongan are closer to the idea of overcoming path dependency in comparison to the case of Semarang. Two factors are found to play an important role in shaping the direction and pace of change: previous experiences of the city governments in dealing with the issues, and the availability of opportunities.

### KNOWLEDGE GAPS AND NEEDS

A long-term program of intervention based on robust research and reliable calculation is required to overcome path dependencies that would not be easy for these city governments alone to develop and implement.



# Session 25 Contested agendas or aligned objectives? Intermediation and the role of non-state actors in the low carbon urban transition

## SESSION ABSTRACT

This session examined the different ways in which state and non-state stakeholders come together in order to propose and advance a low carbon urban transition. It focused on the varied roles that different actors play, the ways in which these actors mobilize climate change logics in the context of their own agendas, and the ways in which such efforts result in contested agendas or aligned objectives in relation to the city's future. It considered climate change responses beyond institutional contexts, where agents located at different governance levels (from municipalities to transnational organizations) interact with both state and non-state partners (business, academia, NGOs) in the visualization and implementation of low carbon responses. The notion of 'intermediation' (Bourdieu 1984, Callon 1986, Iles and Yolles 2002, van Lente, Hekkert et al. 2003, Latour 2005) plays a key role, as multiple agents and organizations get involved in the development of capacity for low carbon, through activities such as management, service delivery, consulting, co-ordination, technology provision, lobbying, awareness-raising and others (Hodson, Marvin et al. 2013). These intermediation processes play a key role in aligning the objectives of different urban stakeholders towards common goals. Yet, they are not exempt from tension and conflict, revealing multiple -and often conflicting- urban agendas at play.

This session was organized by the International Network on Urban Low Carbon Urban Transitions (INCUT), an international network of academic researchers and practitioner organizations that jointly examines how cities across the globe are responding to the challenges posed by climate change. INCUT is based at Durham University in the United Kingdom, and composed of researchers based at academic and practitioner organizations located in Europe as well

as Australia, China, India, South Africa and the United States.

Keywords: Comparative urbanism, intermediaries, low carbon transition, non-state actors, urban politics, governance

## KEY DISCUSSION POINTS

Historical perspectives are important for the low carbon transitions framework, as they are represented politically through inequalities, development models, and the creation of contemporary conditions.

There is conflict in ways of thinking about low carbon, e.g., how residents of a city might consider these transitions in comparison to businesses or the private sector.

Low carbon experimentation is a technique for understanding the boundaries of urban responses.

Why talk about low carbon transitions instead of sustainability transitions or zero carbon transitions? Why is one concept or framework given importance over others? There seems to be a difference between regions regarding which phrase it used as well as the importance of those concepts; e.g., in Australia, low carbon agendas have become less and less popular due to the political climate, which favors 'adaptation'.

## ORGANIZERS

Harriet Bulkeley, Durham University, Durham, UK

Andrés Luque-Ayala, Durham University, Durham, UK

Simon Marvin, Durham University, Durham, UK

## PRESENTATIONS

**Andrés Luque-Ayala**, Harriet Bulkeley, & Simon Marvin, Durham University, Durham, UK

*Urban low carbon transition pathways: An analytical framework*

### SUMMARY

Dominant understandings of transitions have tended to disregard the specificity of the urban. Whilst largely technological and often normative, such approaches pay limited attention to the materiality of the city and the socio-political nature of its flows. They also overlook the scalar challenges to and possibilities associated with multiple and overlapping, formal and informal, governing regimes. Yet, transitions pathways, rather than the result of clean and purposeful ways for scaling niches, are contingent and politically contested processes where a multiplicity of systems, agents and scales come together in an attempt to reconfigure social interests and technology in competing ways.

This presentation proposed a different way of understanding possible pathways towards low carbon transitions. Whilst recognizing the need to ask further questions around the notion of transition itself, this framework acknowledges the multiplicity and contradiction embedded in current attempts to realize low carbon by urban intermediaries.

### KEY LESSONS LEARNED

Transition studies require considering transitions in their political and geographical context. Advancing a low carbon urbanism requires a shift from an 'extractive' model of low carbon transitions, where the focus is in reducing emissions (point source pollution), to an 'embedded' model of de-carbonization based on systemic change.

Whilst acknowledging the multiplicity and contradiction embedded in current attempts to realize low carbon, a way of designing a low carbon urbanism based on the development of novel ways of thinking about the low carbon and development

interface is needed. De-carbonization is then not confined to setting targets to reduce emissions, but involves a host of more or less explicit ways in which carbon comes to be problematized and acted upon in relation to (in this case) the city, thus positioning low carbon as a transformative process.

The design of low carbon urbanism includes establishing a shared understanding of the challenges of low carbon in relation to particular contexts for intervention, forming coalitions and intermediary institutions, identifying the technological interventions to be trialed, and agreeing on the governance principles to be followed.

### POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Transitions towards sustainability depend on social innovation rather than on technical or institutional innovation, and imply calling society's status quo into question as new conventions, regimes of resource consumption, routines and know-hows are envisioned (see also Shove, 2010). Practicing low carbon urbanism involves working with and upon three distinct sets of elements:

The agents, agencies and subjectivities that operate as initiators and partners or act as subjects of intervention;

The objects and flows of the material world involved in the production of carbon; and,

A set of mechanisms and techniques which operate as material, framing and discursive devices capable of influencing both agents and objects.

Governing low carbon in the city transcends the local arena, involving a broad range of agents beyond the local state (Bulkeley and Betsill, 2005). On one hand, non-state actors from private and non-profit sectors are increasingly playing a greater role in shaping, configuring and contesting climate responses in the city (Bulkeley and Betsill, 2013). On the other, making low carbon in the city is a multi-scalar process, made of interactions between agents located at different scales, from the dwelling and the city to transnational and global arenas.

Looking at climate change from the lens of these diverse scales challenges traditional understandings of environmental governance, which assume that decisions are cascaded from international to national to local levels (Betsill and Bulkeley, 2007; Bulkeley, 2005; Bulkeley and Betsill, 2003; Bulkeley and Betsill, 2004; Bulkeley et al., 2009).

### KNOWLEDGE GAPS AND NEEDS

It is important to examine how the very possibility of a low carbon future is being conceptualized within different academic and practitioner settings. Often rationalities exploring transitions to sustainability approach the issue of low carbon as a matter of techno-economic innovation. These understandings of transitions have tended to disregard the specificity of the urban, and pay limited attention to the materiality of the city and the socio-political nature of its flows. They also overlook the scalar challenges and possibilities associated with multiple and overlapping, formal and informal, governing regimes. Yet, transitions, rather than the result of clean and purposeful ways for scaling niches, are contingent and politically contested processes where a multiplicity of systems, agents and scales come together in an attempt to reconfigure social interests and technology.

Understanding transitions is not so much about extracting lessons from a few ideal cases, but about embedding new rationalities and subjectivities. Abandoning an exclusive focus on GHG reduction and climate mitigation (an end-of-pipe approach), low carbon is repositioned as a development approach with transformative political and economic implications. Whilst it is important to acknowledge how transitions are framed by political economic contexts, including issues of resource control and ecological security, rethinking transitions should also mean acknowledging their political aspects, opening up possibilities for the mobilization of low carbon towards a broad variety of social objectives including issues of social justice and urban inequality.

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Mikael Granberg, Karlstad University, Karlstad, Sweden

*Local government, climate change and public-private interaction: The case of Orebro, Sweden*

### SUMMARY

This study takes a close look at how climate change impacts policy practices in local governments. The political arguments and actual local government action are focused on in two cases, where the city's local government interacts with other societal actors (business and citizens) in efforts to create local/regional markets within two socio-technical systems (energy and transport). Consideration is given as to whether this is a functional way to facilitate low carbon transitions within socio-technical systems as well as how these endeavors are perceived by political actors (majority and opposition) and if any conflicting interests in the choice of market pathway can be observed in urban political processes.

### KEY LESSONS LEARNED

Urban policy and practice is central to connecting global standards and knowledge, and national and regional climate change scenarios into particular action in specific contexts. Cities can and perhaps need to be forerunners in climate change policy and practice, which means that researchers can examine cities and local governments to increase understanding of policy practices guiding adaption and mitigation to climate change.

### POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Budgets should include life cycle cost calculations in investments. A focus on department budgeting (fiscal responsibility) can lead to short-term savings (within budgets) instead of promoting long-term investments with greater, both monetary and environmental, payoffs.

Different business models often result in multiple data and measurements, which become confusing and



ultimately near impossible for planning departments to use. This can lead to a fragmented policy agenda.

The municipality and other local actors, especially 'weaker' municipalities, need the support of policy/regulation/legislation/resource allocation from higher levels of government i.e., the national and international level, in order to be successful.

### KNOWLEDGE GAPS AND NEEDS

More needs to be known about conflicting policy objectives (e.g., how does climate change issues interact with other prioritized issues on the policy agenda?), in order to grasp if, how and why city and local governments perceive and can prioritize policies connected to climate change.

The issue of path dependency as both a resource and a hindrance to climate action needs to be explored further. Issues to be focused on include:

Institutionalized governance, administration and policy (are new public management and marketization helpful?);

market solutions and 'green' growth (ecological modernization);

infrastructure and large-scale technological systems;

and lifestyles.

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**Susie Moloney** & Ralph Horne, RMIT University, Melbourne, Australia

*Local government climate change alliances as intermediaries in low carbon urban transitioning in Victoria, Australia*

### SUMMARY

A growing literature indicates the endeavors of local governance including local governments and non-governmental organizations in conducting and calling for actions aimed at low carbon urban transitions. There is evidence that these unusual organizations, occupying middle ground between community and the state, are increasingly significant in driving regional-level coordination and innovation. Their

actions are notable in an era of diminishing political leadership at both the state and federal levels.

The emergence of regional climate change alliances is a significant feature of urban low carbon activity in Victoria, Australia, and is a form of governance that is fostering experiments through energy infrastructure projects and regional-scale urban retrofitting and capacity building initiatives. Understood as intermediaries, their role and effectiveness in creating spaces outside the obduracy of both existing urban governance and socio-technical regimes were analyzed. This analysis within the context of Victoria contributes to an understanding of the roles, types and significance of intermediaries in low carbon transitioning and the extent to which new informal governing arrangements might transform socio-technical regimes.

### POLICY/PRACTICE IMPLICATIONS OF RESEARCH

There is a role for informal governing arrangements in transforming socio-technical regimes. Researchers and universities can play a role in working with intermediaries to build capacity and knowledge, interpret and distribute learnings, facilitating policy transfers and lessons, and act as advocates.

### KNOWLEDGE GAPS AND NEEDS

There is a need for comparative frameworks.

A better understanding of the role of place-based experiments and socio-technical transitioning, and implications for broad-scale change is necessary.

Further analysis of project/initiative efficacy and evaluation of potential for shifting socio-technical systems and social practices is needed.

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Sara Fuller, Macquarie University, Sydney, Australia

*Positioning the university as an urban climate change actor: Governance, responsibility and opportunity*

### SUMMARY

Urban climate governance literature highlights the multiplicity of actors involved in addressing the

challenges posed by climate change. In this context one significant actor – distinct from other state and non-state actors – is that of the university. This presentation reported on empirical research in the city of Sydney with representatives from a range of university departments as well as external partners. It reflected not only on the role of the university as an intermediary organization, but also on the politics and practices of the intermediation process itself.

### KEY LESSONS LEARNED

University responsibility is played out in multiple ways, in recognition of the multiple roles played by universities in urban spaces and internally. It is in a unique position to act on both urban development and climate change.

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Jonathan Rutherford, Universite Paris Est, Paris, France

*Strategies, scenarios and politics of decarbonization in Paris*

### SUMMARY

This study used case study analysis of the role of heating and cooling infrastructure in de-carbonization efforts in Paris. It analyzed the contested nature of the ‘low carbon urban’ and the extent to which it may be productive to explore a more distributed, relational and heterogeneous notion of agency in analyzing activity, capacity and capability to effectuate a low carbon transition.

In seeking to analyze these distinctive configurations and outcomes, the study explored how low carbon stakeholders in Paris have organized differently around and indeed by, particular material sites, objects, resources and infrastructures in attempt to create and sustain visions and implement actions towards a low carbon transition. These infrastructures (e.g., pipes, plants, contracts, financial flows, steam, hot and cold water, coal, olive kernels, etc.) can be said to filter, mediate between and translate interests, visions and actions, and thus contribute actively to shaping the realm of what is possible in urban

low carbon efforts. The aim was therefore to take stock of and understand seriously the matter(s) through which low carbon is proposed, advanced and executed, and to critically explore the work of these vital infrastructures within socio-ecological assemblages that knit together (partially, temporarily, dynamically) diverse and usually conflicting agendas, interests and stakeholders.



# Session 26 Urban Social and Institutional Responses to Global Environmental Change

## SESSION ABSTRACT

Apart from the quantitative significance of cities as contributors to the global carbon footprint, urban areas also play a crucial qualitative role in devising responses to climate change. Cities are the places where most social innovations emerge, reflecting social needs and values on the rise. They provide enabling environments within which integrated solutions addressing complex sustainability problems can be created and trialed across institutional boundaries. Cities are equally the cradle of governance innovations that provide and accommodate experimental configurations to trigger, accelerate, couple and/or rescale social innovations. In addition, cities are increasingly recognized by national governments and supra-national organizations (EU, UN) as solution incubators, helping to learn about alternative and effective response strategies across scales.

Recent examples illustrate how social and governance innovations can become connected systemically in cities to form a crucial driver for multi-domain transitions and multi-scale resilience. In a number of places, activities following this pattern can be observed including, e.g., social solidarity hubs (Rotterdam), social gardening for green space provision (Seoul), crowd-sourced neighborhood developments (Spain, Greece), or novel types of partnerships between diverse urban stakeholders (e.g., Rotterdam, Copenhagen, Brighton, Stockholm, Seoul). These examples represent learning experiments that integrate social and governance innovations. This session discussed different cases of social and governance innovations in cities responding to climate change in terms of mitigation, adaptation and/or transformation. Key questions addressed include:

What are conditioning factors for the emergence of climate change-relevant social and governance innovations in cities?

What is the role of landscape pressures, cultural change, higher-level policy frameworks and translocal networks in this?

What are the dynamic and nested relationships between social innovation and institutional innovation in cities and across scales?

How can we design urban governance frameworks that drive social and institutional innovations in response to global climate change?

*Keywords: vulnerability, resilience, mitigation, adaptation, spatial planning, climate policy, social innovation, urban governance, policy learning, sustainability transitions, adaptive capacity, transformative capacity*

## ORGANIZERS

**Sue-Ching Jou**, National Taiwan University, Taipei, Taiwan

Marc Wolfram, Yonsei University, Seoul, Republic of Korea

## PRESENTATIONS

Szu-Hua Wang, Chinese Culture University, Taipei, Taiwan

Shu-Li Huang, National Taipei University, Taipei, Taiwan

*Synergies and trade-offs of urban spatial planning in mitigating and adapting to climate change in Taiwan.*

## SUMMARY

The institutional framework and planning outcomes of Taipei and Kaohsiung City were examined in the context of spatial planning. This presentation discussed the trade-offs and synergies among spatial planning-related strategies to cope with climate change in terms of both mitigation and adaptation.

## KEY LESSONS LEARNED

Urban spatial planning in Taipei and Kaohsiung has not played a role in either mitigating or adapting to climate change.

CO<sub>2</sub> emissions in both cities have continued to increase with urban development.

The allocation of urban land use and green infrastructure often does not consider how to minimize the impacts from extreme weather events.

## KNOWLEDGE GAPS AND NEEDS

Climate change issues spread across many disciplines, requiring urban planning to function as an over arching platform to integrate issues and strategies from these different sectors.

Future research must develop methodologies at the local level to analyze synergies and trade-offs between mitigation and adaptation, and to help assess and prioritize the cost-effectiveness of different strategies.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Urban spatial planning must overcome current institutional barriers and incorporate strategies at different spatial and temporal scales during the planning process, in order to reduce CO<sub>2</sub> emissions and minimize impacts from extreme events.

Trade-offs between strategies for mitigation and adaptation should be included in plan evaluation and should incorporate viewpoints of different stakeholders.

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**Shailendra Mandal** & Vivekanand Singh, National Institute of Technology, Patna, India

Gregg Garfin, University of Arizona, Tucson, AZ, USA

*Making climate adaptation work: Strategies for resource constrained Indian cities*

## SUMMARY

This study explored the responses of Indian cities to the serious challenges posed by climate change, particularly in the water sector, drawing on theories of 'adaptation as development', ongoing planning initiatives in cities, and the factors that promote or hinder successful climate action plans. It examined associated discourses and actions related to climate adaptation strategies in the urban water sector, in order to identify practical, less resource-intensive adaptation strategies suited to the context of urban India.

## KEY LESSONS LEARNED

Findings suggest that, given the absence of dedicated adaptation planning at the city level, the most effective approaches are those that integrate both development and adaptation criteria.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

It is important to catalyze awareness that water supply and management are the responsibility of not only the municipal corporation or urban water department/manager, but also of urban citizens and the informal actors involved in water supply. While resilience building must ultimately be a joint effort, most of the resilience measures could be initiated at the household or community levels and should have active support from the city municipal corporation.

The urban poor require special attention, as they are the most vulnerable to environmental change impacts and water availability, and have the least resources to cope with changes.

It is important to draw attention to the critical role of groundwater and the need for management of the groundwater resource base. Local and regional governments must create better systems of monitoring and conserving groundwater resources, including improving education on the importance

of groundwater resources, rainwater harvesting and infiltration, and improving conservation and efficiency.

Urban water departments/managers in developing countries need ways to communicate and share information. Global environmental change and urbanization further compel all water departments/managers to develop methods of multi-directional communication and water system transparency that will help each water department/manager better plan in the face of constraints on water availability.

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**Keng-Ming Hsu**, National University Of Tainan, Tainan, Taiwan

Hsin-Huang Michael Hsiao, National Taiwan University, Taipei, Taiwan

*Coping With Climate Change In Urban Taiwan: Lessening Urban Vulnerability And Strengthening Social Resilience*

### SUMMARY

In the 21<sup>st</sup> century, the traditional method of construction cannot resolve the issues of current climate risk. Only through further understanding of the aspects of human/social vulnerability and strengthening resilience, can we improve the overall disaster prevention system. The principal purpose of this study was to review and compare the related literature, both international and domestic, on the social aspects of climate change. The critical comparison can lead to the detection of a 'research gap' between international and domestic research in the field of emerging urban social issues and strategies toward climate change.

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Sue-Ching Jou, National Taiwan University, Taipei, Taiwan

**Jing-Chein Lu**, Central Police University, Taoyuan, Taiwan

*Adaptive city and local climate policies in Taiwan: Institutional alignment and policy transfer*

### SUMMARY

This study examined and compared the adaptation of climate change-related policies in Taipei City and Pingtung County, two of Taiwan's most populated urban areas and most heavily impacted by climate-related disasters. Climate-related plans and other governmental documents were reviewed in combination with in-depth interviews with key policymakers to analyze the implementation by the two local governments. By comparing the similarities and differences of the case study areas with other model international cities, it demonstrates the ways in which local governments in Taiwan are coping with the impacts of extreme weather and purposefully enhancing urban adaptation. The study further explored how these climate-related policies and programs are shaped under international institutions, networks of climate change and domestic institutional settings.

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**John Robinson**, David Maggs, Jon Saltor, Michael Robinson, Robert Gardiner, Roy Bendor, Sidney Fels & Stephan Sheppard, University Of British Columbia, Vancouver, BC, Canada

Meg Holden, Simon Fraser University, Vancouver, BC, Canada

Ann Dale, Royal Roads University, Victoria, BC, Canada

Sarah Burch, University Of Waterloo, Waterloo, ON, Canada

*Emergent dialogue, municipal climate response, and imaginary words: Exploring climate change innovation and engagement processes at the community scale*

### SUMMARY

The locus of innovation and activity on climate change and sustainability has strongly shifted around the world to the municipal or community level. Yet, there is still much to learn about how best to engage communities and citizens in exploring sustainable futures. This presentation reported on two streams of work. The first is ongoing work on community-

scale climate innovation. A recently completed study developed 11 case studies of community climate leadership in British Columbia (BC), Canada and implemented a number of processes of peer-to-peer learning and information exchange. The second stream of work focuses on processes of engaging citizens on climate change and sustainability issues. The results of several decades of work in BC on using landscape visualization and participatory backcasting techniques for such engagement, focusing on recent work on multi-channel (landscape visualization workshops, scenario tools, social media, tabletop games, art, mobile apps and computer games) engagement processes were summarized.

### KEY LESSONS LEARNED

It is possible to engage significant numbers of citizens actively in interactive processes of community engagement focused on the future of their cities.

Different channels of engagement (social media, tabletop games, mobile apps, scenario workshops, computer game-like tools, art, etc.) have different affordances for community engagement, attract different demographics, and thus allow different kinds of issues to be explored. Such processes need to be both 'true to life' and 'fun to use'.

It is more fruitful to use processes of emergent dialogue than of persuasive communication when issues are contested.

### POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Procedural approaches to sustainability that are open to different views and formulations of the problems may offer fruitful ways to engage the public and policymakers.

How issues regarding climate change and sustainability are framed is important. For example, when dealing with citizens, speak to what they know, where they live and their expectations. Frame the issue around what they want their city to look like. Climate change is too remote, too outside their day to

day lives, and thus more difficult to use as a topic of engagement.

Knowledge co-production is key to framing and developing issues.

### KNOWLEDGE GAPS AND NEEDS

Affordances and opportunities of different channels of public engagement.

Finding the best way to engage with the arts community.

Connecting the results of participatory community engagement processes to policymaking and decision making at different scales and levels.

How best to undertake emergent dialogue processes based on a procedural approach to sustainability.





# Session 34 Co-benefits of addressing global environmental change in urban areas

## SESSION ABSTRACT

Meaningful socio-economic development goals and the mitigation of global environmental problems need to change how we develop and manage our cities. Urban interventions can be a critical step to the mitigation of urbanization-led climate change and biodiversity loss. Rapid urbanization in developing countries demands a massive provision of infrastructure, public transportation, housing and jobs for their population as well as a healthy environment. The co-benefits approach refers to the development and implementation of policies and strategies that simultaneously contribute to addressing climate change and biodiversity loss as well as solving local environmental problems, which also have other development impacts, such as improvements in health conditions and economic opportunities. The co-benefits approach is especially important for developing countries, which must overcome many challenges simultaneously with limited capacities and resources.

This session discussed the main obstacles, opportunities and challenges to implementation of environmental co-benefit related policies in urban areas. It focused on multi-disciplinary research and shared lessons on the generation and evaluation of co-benefits as well as areas of further research needed to advance the understanding of urban co-benefits.

*Keywords: urbanization, biodiversity, ecosystem services, climate change mitigation, co-benefits, urban development*

## KEY DISCUSSION POINTS

Once stakeholders know the economic benefits of development, it is important to push other benefits, such as those related to the environment.

Active transportation, such as walking and bicycling, can have as much of an effect on public health as reducing air pollution. Urban form can encourage active transportation through dedicated bike lanes and well-maintained sidewalks.

## ORGANIZERS

Wan-Yu Shih, Ming-Chuan University, Taipei, Taiwan

## PRESENTATIONS

Wan-Yu Shih, Ming-Chuan University, Taipei, Taiwan

*Land use and urban temperature: A case study of Taipei metropolis*

## SUMMARY

Studies have proven that green spaces have a cooling effect on cities and describe the cause of its variation. However, less is known in regards to the scale of the influence beyond the boundary of green spaces. Through an empirical study of the Taipei metropolis, this study aimed to explore the extent to which the cooling effect of green space might be perceived in surrounding areas and how the characteristics of green space might influence such a performance. Maps were created using remote sensing and GIS data that show the change of temperature around urban green spaces. This study also estimated the energy that might be saved due to the temperature reduction caused this cooling effect.

**Daniel Caparros-Midwood**, Richard Dawson & Stuart Barr, Newcastle University, Newcastle Upon Tyne, UK

*Optimized spatial planning against sustainability objectives*

## SUMMARY

To explore the trade-offs between multiple, often conflicting sustainability objectives within cities, a spatial optimization framework was developed that can identify spatial development strategies that perform well or are the best for an individual or multiple sets of sustainability objectives. The methodology entails iteratively investigating a wide range of spatial set-ups of development against their objectives before converging on optimal spatial patterns. To explore the implications of future residential development choices on key sustainability objectives identified by the local planning authority, the method was applied to a case study in the northeast of England, namely: (1) minimizing risk from heat waves; (2) minimizing risk from flooding; (3) minimizing the distance of new development to the current central business district to minimize travel costs; (4) minimizing urban sprawl to prevent increased travel costs; and, (5) preventing the development of greenspace. Spatial strategies were identified that were shown to be best performing (Pareto optimal) across one or more objectives. The results provided urban planners with a range of spatial development planning options that satisfy key objectives. Coupled with further qualitative consideration of issues not amenable to quantified assessment, this approach could provide a powerful mechanism for developing more sustainable urban development plans.

## KEY LESSONS LEARNED

Urban sustainable development under multiple drivers and pressures (i.e., social, economic and climate change) requires a new process to consider and alleviate conflicts, which occur between sustainability initiatives. There is the need for an analytical appreciation of how conflicts interact and how best to mitigate their impacts whilst planning future sustainable development. For example, experience has shown that sustainability interventions in one sector can have undesirable impacts on other sectors, which affects overall sustainability. The most illustrative of this has been the process of urban intensification with the intention of mitigating transport emissions by encouraging the use of

public transport and discouraging private transport. However, as mitigation strategies have failed to halt climate change in the short-term, this compact urban form exacerbates many of these climate related hazards such as heat waves and floods.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

This research has demonstrated the potential to act as a decision support tool to alleviate conflicts between sustainability objectives during urban spatial planning. Through investigating development patterns, a spatial optimization framework can converge on optimal setups of development and provide urban planners with robust spatial development plans, which with further qualitative analysis can directly inform final planning decisions.

The work provides valuable knowledge to planners by pointing towards trends of development. Results demonstrate particular patterns of development which could be mimicked as well as highlighting locales in the study area, which are more ideal for the location of development.

## KNOWLEDGE GAPS AND NEEDS

There is a need for integrated modelling of urban systems as differing sectors affect one another. Treating separate infrastructure individually can lead to maladaptation as interactions are ignored, highlighting the need for modelling over multiple infrastructure sectors.

There is a need for further modelling of the effect of types of development, e.g., in risk modelling, more sophisticated urban heat island modelling based on the layout and design of buildings as well as models of how surface run off is affected by different developments.

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**Hooman Farzaneh** & Mehrnoosh Dashti, United Nations University – Institute Of Advanced Studies, Yokohama, Japan

*Assessment of the co-benefits of climate change mitigation in the urban energy system*

## SUMMARY

A bottom-up approach with an analysis and aggregation of different cities' data is an efficient assessment method to assess the co-benefits of climate change mitigation in the urban energy system. This methodology was initially tested using real data for three different case studies to assess the co-benefits available for: 1) Yokohama's envisioned Smart City Project; 2) electrical load management in Delhi; and, 3) integrated approach to public transportation in the city of Tehran. A comparative analysis was carried out on the basis of obtained results to address in detail the role of executive policy targets to reduce the greenhouse gas (GHG) emissions and air pollution in each city.

## KEY LESSONS LEARNED

This methodology is useful in managing demand of resources and the complex relationship between urban sub-systems and integration of demand and supply sides.

Improving energy efficiency for end users is more important than focusing solely on the supply system.

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Christopher Doll, United Nations University - Institute Of Advanced Studies, Yokohama, Japan

*A tool to assess co-benefits in the urban transport sector*

## SUMMARY

This presentation outlined a methodology that has been used to construct a tool for developing a city-level inventory of the urban transport system. The avoid-shift-improve framework is used to simulate policy options in the main areas of transport policy. The tool is designed to be user-friendly and outcomes are reported in an interactive format, which shows how different policies affect emissions of greenhouse gases, air pollution and energy use. It also provides a function to assess how emissions and energy will develop over longer time periods, and is publicly accessible through the internet. The discussion included how dissemination of the tool will build a database of input data, which can be used to fill data

gaps among prospective users and how results can be compared against those in the database. Finally, there was consideration for how the tool could be extended to provide information on a wider range of co-benefits including those pertaining to urban health from different mobility strategies.

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**Felix Creutzig** & Steffen Lohrey, Mercator Research Institute on Global Commons and Climate Change, Berlin, Germany

*Urban form and the environment*

## SUMMARY

With global environmental change and the rise of global megacities, environmental and social externalities have become increasingly prevalent in determining optimal urban form. There are specific effects on climate change (transport and residential energy use), air pollution, congestion and land rent burden. This presentation described trade-off curves between these externalities and identified individual utilities. Denser urban forms would mitigate climate change, but would increase the land rent burden on citizens. A denser urban form might, however, translate into increased air pollution. But, if higher transport costs for individual transport are combined with easy accessibility for public transport and cycling, air quality could also be improved in dense cities. These results reveal a 'sustainability window' where only a combination of transportation policies, infrastructure investment and progressive public finance simultaneously enables the development of cities and sustainability dimensions. Modal choice, technologies and land rent policies can modify the trade-off curves, better co-aligning urban welfare with beneficial global environmental change.

## KEY LESSONS LEARNED

Denser cities can contribute to climate change mitigation, but can also have a high impact on air pollution. Public transportation mitigates the impact of air pollution, but can also have an impact on cost of living.

50 people per hectare is an appropriate population density, in order to achieve a high level in all dimensions of urban sustainability.

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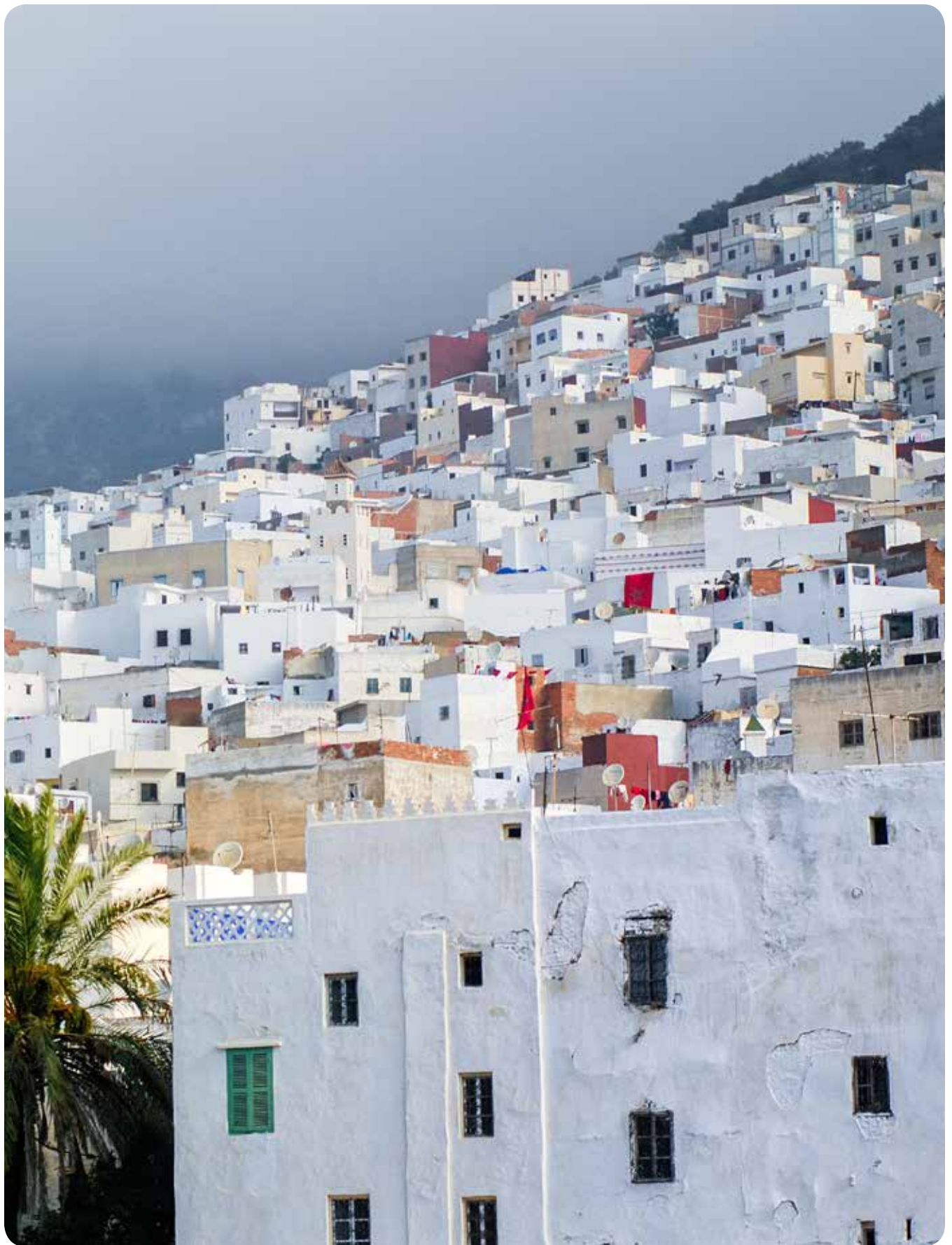
Jose Antonio Puppim De Oliveira, United Nations University, Tokyo, Japan

*Building capabilities for co-benefits in urban areas: Linking local planning and global environmental change through innovation*

## **SUMMARY**

Urban co-benefits are the result of planning processes and the implementation of initiatives that simultaneously contribute to tackling global environmental problems (e.g., biodiversity loss and climate change) and solving local development problems. The field of planning has been slow to incorporate the need to address global environmental challenges in local planning practice. However, recently we have seen a series of initiatives in urban areas that have resulted in the improvement of local development outcomes and the mitigation of global environmental problems. This research looked at the types of technological capabilities cities need to acquire to support and stimulate co-benefits and how cities (sub-national governments) can build those capabilities.

The research aimed to examine the socio-technical transitions that lead to co-benefits based on the growing literature in the area of socio-technical transitions and applied this framework to analyze a series of empirical cases in China, India, Brazil and Indonesia.



# Session 61 Regional Perspectives on Urban Transformations for Adaptation to Climate Change

## SESSION ABSTRACT

Many regions across the globe face social, economic and environmental risk. These shifts and transformations pose serious challenges in view of climate change, land use change and increasing disaster risk. The scale and extent of climate change projected over this century, coupled with resource constraints and other challenges will make business as usual or ad hoc reforms untenable. The search for urban transition pathways towards more sustainable forms of regional urbanism has picked up among academics, practitioners and policymakers. This session aimed to take stock of the transformation trajectories with evidence-based information on emerging pathways for transitioning to sustainable urban development. The session discussed good practices that identify plausible pathways for urban transitions, which will form the basis of future research engagement among the stakeholders.

*Keywords: climate change, adaptation, sustainable development, urbanization, transitions, land use change, disaster risk management*

## KEY DISCUSSION POINTS

Informality, political structures and power relations, and macroeconomics (private sector and economic actors) are all areas that need to be better researched in the dimension of adaptation and transformation. In this context, important points include:

Power-relations cross cut across place-based and people-based vulnerabilities (social and scalar), how this is mediated depends on institutional and scale power relations down to the intra-household;

Informality defines the rules of the game, i.e., institutional power-relationships;

Informal areas are dominant in some countries, therefore it is necessary to make sure these voices are included in the discussion of urban development; to ensure sustainable development these informal populations must be integrated;

In the case of multi-hazard exposures, the drivers of vulnerability are often associated with the level of access to information and political participation; and,

Rapid urbanization is driven by economic decisions and increasingly by private actors or corporations that are building cities; these actors and processes need to be better understood.

## ORGANIZERS

Shuaib Lwasa, Makerere University, Kampala, Uganda

Patricia Romero-Lankao, National Center for Atmospheric Research, Boulder, CO, USA

David Simon, Royal Holloway University of London, Egham, UK

## PRESENTATIONS

Matthias Garschagen, United Nations University, Institute For Environment And Human Security, Bonn, Germany

*Risky change? Bridging state and non-state divides in Vietnam's transforming urban risk governance and drawing lessons beyond*

## SUMMARY

The rapid transformation of Vietnam's cities is coupled with an increasing exposure to the projected impacts of climatic hazards. Resulting from both trends are substantial challenges for urban disaster risk governance, which remains poorly understood

scientifically and politically under-emphasized. This presentation traced the dynamics of urban vulnerability and explored how the responsibilities and capacities for risk reduction and adaptation are negotiated and shared within the country's changing political economy, focusing in particular on the shifting roles of state vs. non-state actors. The research drew on twelve months of empirical research in Can Tho City, the demographic and economic center of the highly flood- and typhoon-prone Mekong Delta.

### KEY LESSONS LEARNED

Considerable rifts exist between state and non-state adaptation actions.

The responsibility for adaptation is an increasingly sensitive topic - it will move up on the government agenda as climate change continues to impact cities' infrastructure and resources, e.g., through increasing transportation and air pollution.

Adaptation is linked to political participation and political legitimacy.

The inclusion of state actors' agendas and their perceptions are essential when doing adaptation assessments. These viewpoints are often neglected, especially in politically sensitive contexts.

### POLICY/PRACTICE IMPLICATIONS OF RESEARCH

A greater understanding, both scientifically and politically, of the dynamic impacts of urbanization and transformation on risk, vulnerability and adaptation, and the changing governance at the interface of state and non-state actors, could facilitate more successful and inclusive adaptation actions.

### KNOWLEDGE GAPS AND NEEDS

The adaptation of institutional mechanisms is needed, in order to more strongly integrate state and non-state adaptation action.

Both state and non-state perceptions of problems and solutions need to be considered.

Timelines, quality criteria, etc., must be re-considered in adaptation planning.

Although adaptation can be a trigger of change, it can also be slowed down by inertia and resistance in the wider system; hence, adaptation action should be embedded within the wider set-up of state-society relations.

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**Richard Sliuzas**, Johannes Flacke, Eduardo Perez-Molina & Victor Jetten, University Of Twente, Enschede, The Netherlands

Shuaib Lwasa, Makerere University, Kampala, Uganda

*Using spatial scenarios to explore possible transformation pathways for African cities*

### SUMMARY

The development of African cities and their responses to the challenges of climate change is surrounded by uncertainty. Issues at the heart of this uncertainty includes: the lack of reliable data on patterns and processes of urban development and climate; likely future urban growth trends; possible changes in societal behavior that may influence the previous issues; local and regional level climate change patterns that may affect weather patterns and in some instances possibly lead to large scale population migration; and, the ability of local governments and other actors to identify and implement effective adaptation strategies.

This presentation examined recent work on integrated flood risk assessment in Kampala, Uganda, a fast growing city where local flash floods are expected to become more frequent. The key question addressed was: Can spatial scenario analysis and planning support the transformation process of African cities, and how can good practices be developed and shared?

### KEY LESSONS LEARNED

There are significant gaps and inaccuracies in data available on urbanization and natural environmental conditions and processes in cities such as Kampala and throughout sub-Saharan African.

Dynamic modelling approaches can be effective tools for communicating key issues on the relationship between urbanization and environmental change to a broader audience.

Stakeholder engagement of the poor and vulnerable with professionals, local and national governments and NGOs is a critical aspect of any transformation process, as success will depend to a large extent on behavior change.

Land ownership - surveying and demarcating wetlands in Uganda is conceptually and practically difficult because of seasonal hydrological dynamics, but also because of historical land demarcations and titling due to private ownership of wetlands.

### **POLICY/PRACTICE IMPLICATIONS OF RESEARCH**

National and local laws and legislative frameworks reveal several gaps in flood risk management. In order to better implement flood risk management, laws and regulations must be reinforced so that they do not create ambiguities or conflicts.

An integrated approach to flood risk management requires collaborative planning that involves different sectoral municipal departments e.g., engineering department, planning department, public services, health as well a strong cooperation and coordination with private and civic stakeholders.

Research must have implications for the scale at which options and solutions to the problems are addressed. The long-time practice of micro-scale interventions has not yielded solutions. Strategic city-regional scale research that recognizes multi-level governance is useful, but challenging, given the potential jurisdictional differences. These differences, however, must be addressed to reduce flood risk in newly developing areas.

Multi-faceted solutions from household to city-regional scale are needed to reduce the problem in current terms, but also mitigate or avoid problems for newly developing areas in the peri-urban zones.

### **KNOWLEDGE GAPS AND NEEDS**

Advances in urban growth modeling that would determine spatially explicit risk by applying vulnerability functions, varying with building typology and flood depth, for use to estimate the monetary value of risk in the city.

The effect of spatially varying patterns of rainfall needs further exploration; better data (e.g., extensive rainfall time series, higher temporal resolution of rainfall measurements) would significantly contribute to improve results.

The coupling of climate models with other models within the current framework could allow, for example, the simulation of future climate change trends responding to greenhouse gas emissions (e.g., using regional climate models).

It is important to test the framework and the relative tools for operationalization in other study areas.

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Olivia Bina, University Of Lisbon, Lisbon, Portugal

*Squaring circles: Developing the arguments and framework for the definition of sustainable urban scenarios capable of engaging with global sustainability constraints*

### **SUMMARY**

Based on her seminal intervention, Donella Meadows would most likely argue that, if we want “to sustainably transform our urban future” we must first have a clear vision of how we desire that future to look, and would argue for a new scientific approach that we now call ‘sustainability science’ (International Society for Ecological Economics, 1994). Given what we know today about global change, tipping points and thresholds, which impose an understanding of planetary challenges and their translation to the urban scale, Meadow’s call for envisioning a sustainable future is all the more challenging. Failing to do so in relation to urban sustainability within the global context may invalidate the attempt to shift towards sustainable development. Drawing on an EU-funded research project on urbanization in



China and Europe (URBACHINA), this presentation proposed a conceptual framework for the definition of sustainable urban scenarios, and reflected on its strengths and weakness based on three applications of the framework.

### KEY LESSONS LEARNED

Global environmental change and climate change do not drive transformation in China. The only connection is through resource scarcity concerns and related techno-scientific fixes.

Urbanization in China is viewed as the engine of growth.

Questions being asked in China regarding urbanization include: how can urbanization help achieve the goals of growth or, at best, development? What is not being asked is: how can urbanization help achieve sustainable development? (this in itself is a paradigm shift)

Incremental change is very unlikely to be enough to respond to known (let alone unknown) challenges, and can lead to costly lock-in.

The pursuit of better science needs to be combined with a long-term, shared vision for a desirable future for all that is both fair and ecologically sustainable; i.e., the power of vision can help us move beyond the incremental, disciplinary boundaries and scientism.

### POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Care must be taken when framing issues and agendas, i.e., futures cannot be discussed via limits or scientific boundaries, which leads to asking nations to make sacrifices.

Bold and hopeful approaches can lead to better choices, but they need a different language and different ways of thinking about the future.

Different modes of development often outpace each other (e.g., urbanization occurring faster than economic growth), which is evident in the haste with which solutions are sought. This ultimately leads to sub-optimal choices and failure to address

problematic paradigms. More adequate planning and governance process tools must be found to address this issue.

### KNOWLEDGE GAPS AND NEEDS

Is a low-carbon, smart or eco-city enough of an inspiration for the 21<sup>st</sup> century?

How much is the enduring promise of science and technology worth keeping or do we need to question it?

Trends in perspectives on the future currently skew in terms of population, economy, governance, technology, etc. (proximate drivers), but only in rethinking values, needs, power structures, knowledge and understanding, and culture (ultimate drivers) can the kind of change required by global environmental change's challenges be envisaged.

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**Patricia Romero-Lankao**, Joshua Sperling & Daniel Runfola, National Center For Atmospheric Research, Boulder, CO, USA

*Exploring health risks in urban Latin America and Asia*

### SUMMARY

This presentation analyzed if, and under what circumstances, urban populations experience risk in Mumbai, India; Bogota, Colombia; Mexico City, Mexico; Santiago, Chile; and Buenos Aires, Argentina. It suggested an integrated approach to the interaction between hazard-risks and vulnerability of urban populations under multiple stresses and assessed their adaptation capacity, i.e., ability to perceive and respond to hazards. Finally, it explored whether or not urban risk depends on scale, and if hazards, adaptation capacities, responses and their underlying societal and physical drivers vary across urban households, neighborhoods and cities.

### KEY LESSONS LEARNED

Scale matters in the study of urbanization and risk.

The level of urbanization is not only correlated with coping and sensitivity, but also the rates at which

countries are urbanizing, i.e., rapidly urbanizing countries experience higher levels of vulnerability.

Urban vulnerability and risk varies at the spatial/temporal scale, but also with the analytical dimensions selected for analyzing the process.

If studies focus on the national level only, the potential data from ethnographic work can be overlooked.

### **POLICY/PRACTICE IMPLICATIONS OF RESEARCH**

Understanding specific hazards and actions taken at various scales, e.g., household level, neighborhood, and city/regional level, provides richer insight into more comprehensive policy options.

A greater understanding of determinants of capacity, which vary with scale, and actions, which are based not only on access to assets and options, but also physical/environmental conditions, can reduce maladaptive approaches.

### **KNOWLEDGE GAPS AND NEEDS**

Although communities often have portfolios of strategies against hazards, actions at the neighborhood level need further study, in order to enhance the capacity of communities to respond and adapt.

The development and research into robust city-wide actions.

Informality is a city-wide political power issue that defines legality, which needs further research, as it is a key determinant of risk and vulnerability and effectiveness of actions that people take against threats to which they are exposed.

Further unpacking of concepts like 'transformation' is needed.

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Senay Habtezion, International START Secretariat, Washington, DC, USA

*The politics of devolution in Africa: Implications for urban disaster risk reduction & disaster risk management*

### **SUMMARY**

By 2030, Africa will pass the 50 percent 'urban' milestone. By 2050, there will be two billion Africans with 60 percent living in cities. Denser urban settlements require effective urban disaster risk reduction (DRR) and disaster risk management (DRM) across all scales of governance. However, the upsurge in urban and population growth in the continent is taking place against the backdrop of distressing deficits in infrastructure, public services and governance. Lack of devolvement of power to local governments as well as the resistance of national governments to commit to meaningful decentralization, could hamper DRR & DRM efforts in African cities. This presentation situated urban DRR and DRM within the context of failures of the federal experiment in Africa (colonial legacy), the resultant highly centralized systems of governance and challenges within ongoing efforts at decentralization. Given the historically slow pace of political reforms geared towards decentralization, more effort should be made to empower African cities through transnational climate processes.

### **KEY LESSONS LEARNED**

Perceived benefits of 'encouraging experimentation and learning from diverse policies adopted at multiple scales', coupled with frustration with the politics of ongoing international climate change processes have contributed to increased advocacy for polycentric approaches to mitigation, adaptation and disaster risk reduction and management (DRR/DRM).

Cities are now at the forefront of advocacy for these pluralist approaches and they may well become a key feature of the post-2015 climate regime. In the African context, given the complex nature of the politics of decentralization, it is difficult to see how polycentrism would apply to the climate effort in the region, and specifically to DRR/DRM.

While, at least in theory, devolution of more power to developing-country city governments should lend itself to strong DRR/DRM, this is not born out by robust evidence.

As the debate over the merits (and demerits) of polycentrism as well as the role of cities in addressing the myriad challenges of GEC, including climate change continues, it is important to have a better understanding of the political angles of the cities-DRR/DRM nexus. In the short run, robust DRR/DRM in cities will likely require strong state presence and, in the long-term, conscious and sustained effort should be made to leverage municipal empowerment via extra-national GEC processes.

### **POLICY/PRACTICE IMPLICATIONS OF RESEARCH**

City-central relations are critical constitutional arrangements that determine the devolution of power within a state with all the attendant ramifications of decentralized governance, which are central to effective DRR/DRM. There is lack of strong decentralized governance in Africa; this is, at least in part, a function of historical and geopolitical actualities in the region.

Political experiments in decentralized governance in Africa have led to diverse outcomes depending on colonial legacy and the ensuing nation-building processes. Development assistance-related prerequisites have also left a strong imprint on local-central government relations in the continent. By and large, however, devolved approaches to governance (with the possible exception of South Africa) have not succeeded even in countries that have constitutionally mandated federal political frameworks (e.g., Ethiopia and Nigeria).

While there is a great merit in polycentrism and the role of cities in tackling GEC challenges, the constitutional and political context in which cities function could further or thwart their contribution. Understanding the political milieu of city-central relations is key to the design and execution of suitable mitigative and adaptive interventions for Africa's expanding cities

### **KNOWLEDGE GAPS AND NEEDS**

While there has been extensive research on governance and economic development, the politics

of the DRR/DRM nexus has not been subjected to rigorous inquiry.

The complex relationships among the different typologies, agents, scales and/or attributes of national and urban governance and vulnerability to GEC are understudied.

Little is known on the links between devolved governance and DRR/DRM. The existing literature does not specifically address the question of if, and how decentralized governance can strengthen DRR/DRM in developing countries, much less in the African regional context. Place-based research on this crucial link with help to better understand the feasibility and desirability of decentralization for robust DRR/DRM as well as the modalities for operationalizing devolved governance for DRR/DRM in Africa.



# Session 70 Resilience and adaptation strategies for transitioning to a sustainable urban future

## SESSION ABSTRACT

This session was organized as a result of the relevant scientific and technical information which could contribute to understanding climate change dynamics (natural variability and human-induced), the impacts and necessary adjustments for adaptation measures. The urban sector is among the most vulnerable, due to changes in the frequency, intensity, spatial extent, and duration of extreme weather and climate events. Different regions of the world may experience changes in the patterns of temperature and precipitation, and be affected by extreme events (e.g., storms, heavy rain, drought) which can be linked to El Niño, La Niña, or other natural phenomenon.

Each region has different physio-graphic and socio-economic conditions that require attention and a clear definition of strategies and priorities with regards to adaptation policies, in addition to the governance process. The difficulties lie precisely in the set of different interests; wherefore the government, social organizations and networks are essential for the governance system. It is necessary to expand the technical, political and institutional support. The surveys, assessments and mapping should assist civil society in favor of actions compatible with the regional and local scale. The governance processes should encourage the participation and understanding of all citizens, and the transfer of knowledge should be clear, with wide dissemination and discussion forums. Within this perspective, this session was based on strengthening relations between different sectors of society in addressing the challenges posed by climate change, adaptation measures and resilience.

*Keywords: resilience, adaptation, transitions, sustainability*

## KEY DISCUSSION POINTS

Private sector engagement in the conversations of adaptation and resilience remains a challenge for governance. Key points and questions include:

To what degree can we depend on the private sector to adopt adaptation and resilience strategies beyond using insurance companies for their own internal risk assessments?

Interference, whether it is from government policy, regulation or market measures, is needed to affect the choices of the private sector;

Framing – the private sector (developers) is building the city, therefore, if one can identify an interest or incentive towards sustainable development, there could be progress;

Investment and education of the private sector by the general public drives demand for developers to produce better, more sustainable solutions;

The power asymmetries of companies (e.g., water and energy) are so great that in many cases (cities) one can, as a consequence of governance fatigue, (i.e., time and energy in participatory processes that ultimately does not change these fundamental power structures), witness a post-governance phase where more direct action around these issues from civil groups is taken;

Ultimately, actors must be identified in each urban context, in order to find incentives or triggers for developing more sustainable solutions – then progress can be made; and,

Is it possible to come up with systems of intervention from understanding actor networks in case studies that aggregate to the global scale, in order to transition

to a more sustainable future? What will we learn from comparisons of urban case studies? Is it possible to aggregate them to produce a general typology or check-list of factors that should be considered when engaging in the building of resilience or sustainable solutions in a particular urban setting?

## ORGANIZERS

Christopher Boone, Arizona State University, Tempe, AZ, USA

William Solecki, Hunter College - City University of New York, New York, NY, USA

Andrea Young, State University of Campinas, Campinas, Brazil

## PRESENTATIONS

**Robin Goodman & Hartmut Fuenfgeld**, RMIT University, Melbourne, Australia

*From strategy to action: Climate change adaptation and local government planning processes in Australia*

## SUMMARY

Southeastern Australia is one of the urban climate change hotspots of the developed world, where multiple risks overlap, creating significant threats to urban populations and challenges to urban planners aiming to reduce the vulnerability of people, infrastructure and services. While it is generally assumed that Australia as a nation has a comparatively high adaptive capacity, much of the climate change adaptation efforts seen to date have taken place at the local government level. Among municipalities, significant differences exist with regard to local government engagement in climate change adaptation planning and, even more so, commitment to proactive implementation of adaptation action. While many local governments have developed adaptation strategies and climate risk assessments, few have progressed to a stage of implementing meaningful and effective adaptation actions. Land use planning is a pivotal mechanism through which

adaptation strategies can be turned into actions. Comparing three cities (Bendigo, Melbourne and Geelong) with different climate risk profiles, of different size and differing progress with adaptive urban planning, the extent to which strategic thinking around responses to climate change is impacting land use decision making frameworks was examined.

## KEY LESSONS LEARNED

Individual and organizational leadership, institutional innovation and collaboration are critical factors in addressing the strategic challenges that cities face in the context of climate change impacts.

The climate of political and public discourse has affected the sense of urgency in Victoria regarding climate change adaptation action and has affected the sense of legitimacy that local government planners must make decisions on that basis.

Adaptation planning and preparation that have not translated into planning action are a result of how climate change problems are framed, which is often in terms of corporate risk and managing that corporate risk. This results in competing claims, where often the loudest and most urgent usually wins, with concerns regarding climate change often considered too distant. Planning has a tendency towards focusing on the bureaucratic tasks in order to avoid the difficult issues, e.g., establishing committees, writing cross organizations reviews or strategies.

There remains a critical lack of leadership on climate change at the national level in Australia.

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**Bart Lambregts**, Kasetsart University, Bangkok, Thailand

Marika Bontenbal, Germany University of Technology In Oman, Muscat, Oman

How do different urban development practices condition the potential for building resilience? A comparative case study of Thailand, Oman and The Netherlands

## SUMMARY

Increasing city resilience to the impacts of climate change and other game-changing developments presents a daunting challenge for societies across the world. One aspect of the task has the character of retrofitting; introducing resilience-increasing measures in urban areas that came into being during times when 'resilience' and 'adaptive capacity' were not ubiquitous terms. Another aspect is to integrate resilience-increasing mechanisms into contemporary urban development practices. A comparative research framework was developed that looks at the question of how different urban development practices and their typical urban development outcomes condition the opportunities and challenges for applying mechanisms and incentives commonly associated with the promotion of urban resilience. Case studies in Thailand, Oman and The Netherlands were used to represent three divergent urban developments (led by corporate developers, private households and public/private partnerships, respectively) - a first step in assessing key characteristics and the typical urbanization patterns they produce.

## KEY LESSONS LEARNED

The results presented are not completed research, but instead intend to identify and tentatively explore what could be an important new area of attention for urban resilience research:

Insights emerging from this literature as well as observed Omani, Thai and Dutch urban development practices fuel the belief that efforts aimed at integrating resilience thinking in urban development practices ought to be very sensitive to the particularities of these practices.

While urban development in parts of the Global North often is more or less effectively guided by forward-looking planning policies drafted and effectuated by more or less well-positioned and capable planning authorities including straightforward identification and targeting of key actors (e.g. planning authorities) and processes (e.g., recurrent plan making exercises), conditions may be rather different elsewhere (e.g.,

actors and processes of consequence may not be that easily identified and/or targeted).

Each national and potentially each local urban development context can be thought of as characterized by a unique division of labor and power between the public authorities, the (corporate) private sector and the general public (in their role as citizens and consumers/end users). Each context will be home to a unique combination of laws, regulations, instruments and (cultural) practices that govern the way urban development takes place.

Different actor constellations and different institutional contexts produce different urban development practices that in turn generate different outcomes, among others, in terms of urbanization patterns, ownership characteristics and provision of public amenities (social accessibility of space, etc.).

Different urban development outcomes tend to produce different vulnerability characteristics - even if environmental conditions and climate-related threats were to be similar everywhere - which requires a variety of approaches to mainstreaming urban resilience.

Approaches footed in 'Northern' traditions, assuming that public authorities are at the wheel of the urban development process and avail of effective urban planning instruments, may not go far in contexts where urban development is predominantly managed by the corporate private sector and/or where there is no such thing as a formal planning process.

Tailor-made approaches are needed in practice, while theory should be more responsive to the fact that resilience thinking needs to be 'mainstreamed' in a great variety of urban development practices.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Enhanced conceptual understanding (and awareness) of the complex relationships between urban development practices, their outcomes and associated vulnerabilities, and the resulting opportunities and challenges for building urban resilience will help

those attempting to build and/or mainstream urban resilience in the urban development practice to 'read' situations more clearly and facilitate more efficient and effective development and application of 'tailor-made' resilience-building strategies.

## KNOWLEDGE GAPS AND NEEDS

How do different urban development practices foster the potential for building urban resilience?

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**Ayyoob Sharifi** & Yoshiki Yamagata, Global Carbon Project, Tsukuba, Japan

*Principles and criteria for urban resilience: A Critical analysis of the literature*

## SUMMARY

The notion of resilience is rapidly gaining ground in the urban sustainability literature. This presentation reported on the preliminary results of a critical analysis of a large number of peer-reviewed papers on urban resilience. Through this analysis, the study introduced a set of principles and criteria that can be used to develop an urban resilience assessment index. Development of an assessment framework for evaluating the extent of resiliency of urban areas can be an effective way of incorporating resiliency-related issues into urban planning processes. It is important to identify resilience-related principles and criteria that should be embedded into the assessment framework. Criteria for assessment of the resilience of urban areas are divided into several main themes that cover various dimensions of sustainability. These themes are further broken down into major criteria to account for a variety of resilience-related aspects. The resilience assessment index has the capacity to provide decisionmakers with a clear and comprehensive picture of the resilience of a development proposal and support them in making better informed decisions. Results indicate that, on many occasions, making trade-offs between different resilience criteria would be inevitable.

## KEY LESSONS LEARNED

A large volume of research exists on urban resilience, but it is mainly discipline-based.

Adaptation aspects of resilience have not received enough attention.

There are no appropriate metrics and indices for assessing the resilience of cities.

Such indices can play the role of a decision support system and facilitate a more informed decision making process.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

'Resilience' is somewhat of a buzzword, similar to 'sustainability', however, whereas the latter has many assessment systems or toolkits, the former does not. Through understanding the main principles of resilience (both mitigation and adaptation), a practical toolkit that includes criteria and indicators could be developed for policymakers.

## KNOWLEDGE GAPS AND NEEDS

Develop indicators which can be quantified for easy delivery to policymakers.





# Session 90 Shared learning across coastal cities: Impacts, vulnerability and socio-ecological responses

## SESSION ABSTRACT

Although cities make up a very small percentage of Earth's land surface, coastal environments have much higher concentrations of urban land area (10%) and urban populations (65%) than other ecosystems. Throughout history, human settlements have developed alongside ocean coasts, river deltas and estuaries, given the multiple ecosystem services provided by these unique land systems as well the vast economic and global trade opportunities concomitant with seaports and transportation networks along waterways. In an era of increasing environmental changes including sea level rise, and more frequent and intense tropical storms and storm surges, these unique coastal ecosystems are dramatically impacted in multiple ways: degradation of fisheries and protective mangroves; freshwater security from flooding and pollution; and, land subsidence on coastlines are just a few of the challenges.

Meanwhile, a large number of megacities – Mumbai, Rio de Janeiro, Dhaka, Lagos, etc. – are at high risk, given the socio-economic and development challenges they already face, which are exacerbated when extreme events and natural disasters occur. Their resilience and ability to adapt is quickly tested – this is even the case, albeit to a lesser degree, in cities within the Global North such as New York City. What can be learned and shared by coastal cities in different regions around the world with respect the socio-economic and ecological challenges in light of global environmental change? What are the risks and coping strategies, in particular, of vulnerable populations? What, if any, are the synergies between disaster risk reduction and climate change adaptation and how is this being applied in urban coastal areas? What governance and infrastructural (both hard and soft) opportunities and challenges exist in these coastal communities? How can they become more

resilient and, furthermore, low-carbon in the future?

*Keywords: coastal cities, disaster risk reduction, climate change, adaptation, disaster management, resilience, governance*

## KEY DISCUSSION POINTS

More comparative analysis across cases in the Global North and Global South is needed.

Responses can never be uniform given the circumstances of events, the relationship with communities and government, and underlying power structures, but sharing of 'success' stories would be useful, particularly for developing cities.

Low-carbon policies that encourage the application of both mitigation and adaptation, including green infrastructure, are needed in urban and urbanizing areas.

Public participation in the decision making process, increasing awareness of urbanization processes with climate change interactions, and human/environmental protection should be framed and communicated in ways that are sensitive to the needs and capacity of the respective urban area or community.

## ORGANIZER

Xiangrong Wang, Fudan University, Shanghai, China

## PRESENTATIONS

**Xiangrong Wang**, Xiang Li, Minlei Qian, Huanran Ling, Guotao Peng & Yujing Xie, Fudan University, Shanghai, China

*Climate change and urban growth: Impacts and responses. A case study of Shanghai, China*

## SUMMARY

Urban growth is a complicated process involving the spatial-temporal changes of all socio-economic and physical components at different scales. Usually, urban growth is dependent on socio-economic variables and spatial variables. Urban growth also can respond to climate change by adapting to its impacts and reducing vulnerability related to climate change in the short- and long-term. Responding to climate change involves an iterative risk management process that includes both adaptation and mitigation, which can provide a wide variety of policies and countermeasures from the government, and patterns of urban growth in response to climate change.

The impact of climate change on urban infrastructure was the focus of this research. Using Shanghai, China as a case study, the eco-vulnerability assessment, urban infrastructure distribution and strategies for urban sustainability were explored.

## KEY LESSONS LEARNED

In comparison to the cities in this study, Shanghai ranks third highest in terms of environmental challenges.

The Shanghai average temperature has risen over the last 15 years. The rate of change is higher than the national average rate of change.

The urban heat island in Shanghai is increasing per year and precipitation has become more irregular.

Sea level rise increases are found in the China East Sea, higher than other estuary areas in China.

Tropical cyclones are increasing in intensity and becoming more frequent (the highest in 100 years).

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Master planning that includes eco-network planning incorporating greenways and walkways is important for adaptive capacity to climate change.

Planning must integrate the water supply system, power and gas system, and communications system.

Strategies for urban infrastructure including flood control construction have given priority investment to the city-center area, but upstream and rural areas must also be included.

## KNOWLEDGE GAPS AND NEEDS

This framework could be applied to other estuary cities, in order to enhance urban green infrastructure development and the coordination of urban growth and environmental protection to reduce climate change impacts.

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**Peter Elias** & Olatunji Babatola, University Of Lagos, Lagos, Nigeria

*Differential vulnerability and dilemma of responses to climate change in low-income coastal communities of Lagos*

## SUMMARY

The impacts of climate change are increasingly recognized and concerted efforts are ongoing to mitigate and adapt. The emerging reality, however, indicates that low-income coastal communities are more vulnerable to climate change. This is because, in addition to changes in flooding, temperature and rainfall, they will also be affected by the rise in sea level, wave heights and accelerated coastal erosion. Coastal communities near Lagos, Nigeria already suffer from high levels of poverty, deprivation and spatial segregation. Profiling vulnerability for low-income coastal communities to climate change is very crucial for adaptation planning. This research adopted a qualitative assessment of the state of knowledge and capacities in planning climate change mitigation/adaptation in Lagos coastal communities by exploring both actual and perceived vulnerabilities by individuals, social groups and communities.

## KEY LESSONS LEARNED

The policy responses to climate change impacts are usually spontaneous, lacking in data and knowledge in terms of drivers and pathways, spatial risk and vulnerability. As a result, there are many challenges for government response and often

inadequate responses have provoked criticism that has sometimes led to violent reactions from affected communities.

Recent flood events (2010 and 2011) have demonstrated insufficient adaptive capacities and the inadequacies of current planning methodology.

Areas included in the Lagos Master Plan are governed by a complex structure comprised of different levels of administration and government. They have difficulties working together, resulting in competing goals among the various levels.

### **POLICY/PRACTICE IMPLICATIONS OF RESEARCH**

Identifying hotspots and assessing different vulnerabilities and impacts to climate change, understanding perception and awareness, assessing capacity of existing systems and processes to adapt, and the willingness to deploy new adaptation strategies can inform recommendations for urban planning and adaptation.

### **KNOWLEDGE GAPS AND NEEDS**

To construct effective sustainable urban adaptation approaches, responses must involve coordination and cooperation at multiple levels of government agencies and stakeholders, and particularly the private sector, which is often absent from these discussions.

The state of Lagos should strengthen strategies and partnerships with relevant agencies beyond the state government to take advantage of available resources at all levels towards building capacity for climate change adaptation.

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**Yangfan Li**, Xiamen University, Xiamen, China  
Xiaoxiang Zhang, Hohai University, Nanjing, China

*Development and application of a methodology for spatial vulnerability assessment of coastal environmental change in China*

### **SUMMARY**

This study improved the framework of 'exposure-sensitivity-resilience' for vulnerability analysis. The

pressure indicators of the rapid urbanization process (population growth and land use change) were introduced to represent the exposure of the system. Based on the resilience of coastal land types, such as mangrove wetlands, an evaluation framework for regional environmental vulnerability of coastal urbanizing areas with spatial analysis was developed. Using Haikou, Hainan Province, China as a case study, the pressure of increasing population, the sensitivity of geographical space and the resilience of coastal natural habitats in the urbanizing coastal areas were calculated. Subsequently, the value of environmental spatial vulnerability was evaluated and mapped.

### **KEY LESSONS LEARNED**

Maps from 2003 and 2006 reveal that high risk areas are concentrated along the coastal areas in Xiamen.

When the changing conditions of these rapidly urbanizing areas were compared with urban planning processes, it is found that high risk areas are located in areas where new industrial parks are being developed.

Mapping spatial vulnerability in Haikou, the areas of high vulnerability are rapidly urbanizing, whereas, the areas with low vulnerability are protected areas, such as the mangrove ecosystem.

### **POLICY/PRACTICE IMPLICATIONS OF RESEARCH**

This research could be used to help develop early warning mechanisms for coastal disasters.

Creating multiple scenarios offers better prediction of vulnerability alongside the rapid urbanization processes in these areas and will inform decision making and greater socio-ecological protection.

### **KNOWLEDGE GAPS AND NEEDS**

The next step is to expand the methodology and results to the Eastern and Western Taiwan Strait, to understand the interactions and telecouplings between mainland China and Taiwan.

The integration of social science methodologies into the framework.

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Ebinezor Florano, University Of The Philippines,  
Quezon City, The Philippines

*Community governance for disaster recovery and  
resilience: Four case studies in The Philippines*

## SUMMARY

In the aftermath of disasters, government agencies usually lead in recovery efforts. Communities, more often than not, are reduced to passive recipients of recovery and rehabilitation. Yet, their roles in post-disaster recovery programs have already been recognized as important by the literature on community-based disaster risk management. This study asked the following research questions:

What is the role of communities in the disaster recovery process and in building resiliency?

Under what conditions does community involvement result in effective recovery and resiliency? Are they affected by local conditions (i.e., biophysical conditions and geographical terrain, local socio-economic and political conditions, and culture and traditions)?

Given the potential of community involvement in disaster recovery efforts, what policies must be instituted in the Philippines to make them partners in building resilient societies?

Twelve barangays (the smallest administrative division in the Philippines and is the native Filipino term for a village, district or ward) in highly urbanized Tacloban, Iligan, Dagupan and Marikina were chosen as case studies. These four cities have been hit by catastrophic typhoons in the past (i.e., Typhoon Haiyan in November 2013, Typhoon Washi in December 2011, Typhoon Parma in September-October 2009, and Typhoon Ketsana in September 2009, respectively), but have managed to recover.

## KEY LESSONS LEARNED

Barangays within the studied cities have remained 'passive-reactive,' stuck in the pre-NDRRMC (National Disaster Risk Reduction and Management

Council) era because there are no concrete local recovery plans (e.g., housing, livelihood for those who lost jobs, availing of home and life insurance, charting of an alternative development path in the aftermath of a worst-case disaster scenario, etc.) even in the most DRRM-prepared barangays of Marikina and Dagupan. The 'reactive' recovery planning at the barangays could be an offshoot of the post-disaster recovery planning at the national government level.

With their dependency on assistance from the higher authorities, barangays and even higher local government units (LGUs) wait for directives to assess damages and losses and propose recovery and reconstruction plans from the NDRRMC and member agencies. This has historically been the norm, with the only difference today being that the evaluations are more rigorous with the use of the Post-Disaster Needs Assessment (PDNA) methodology.

In the studied barangays, there are no plans, organizations, and capacity building for disaster recovery, and hence, is the weakest link in the country's DRRM system.

As no concrete plans to 'build back better' once a worst-case disaster scenario hits the barangays exist, in such case, there is a preponderance on the part of barangay officials and residents to rely on 'God's help' and even fatalism, however, barangays officials and residents expressed willingness to undertake recovery planning if they will be trained and guided.

In general, the Disaster-Resilient Community Index (DRCI) computations reveal two lessons:

Cities which recovered relatively faster (Marikina and Dagupan vis-à-vis Iligan and Tacloban) may have made themselves more resilient through time. This may mean that building resiliency does not happen overnight. Issues and problems related to disaster recovery like housing and livelihood, the two most cited problems by disaster victims, should be addressed immediately to lessen their exposure to hazards and reduce their vulnerabilities.

It was discovered that severely damaged barangays received lower DRCI, which means they are less resilient compared to moderately- and least-damaged barangays.

### **POLICY/PRACTICE IMPLICATIONS OF RESEARCH**

Amend Republic Act 10121 (Philippine Disaster Risk Reduction and Management Act of 2010) to include 'Pre-Disaster Recovery Planning' (PDRP) as a key component of recovery and rehabilitation of the DRRM.

Require all government agencies to draft their own continuity plans through a new law or amendment to RA 10121. More often than not, post-disaster recovery efforts are focused on reviving the economy, infrastructure, agriculture, tourism, etc. Little attention or no attention is given to revive governance institutions like government offices, legislative council offices, etc. These are essential offices for the implementation of recovery programs, plans and projects. Hence, there is need for continuity plans.

Relocate the poor from dangerous areas to safer places and provide alternative sources of livelihood with proper consultation. Before a disaster strikes, they should be relocated, which is more cost-efficient rather than providing them with relief goods each time there is a calamity. They should also be provided with alternative sources of livelihood so they do not return to disaster-prone areas once the recovery is complete.

### **KNOWLEDGE GAPS AND NEEDS**

Research should be undertaken to gather experiences of frontline offices of various government agencies (national government agencies, local government units, government-owned and/or -controlled corporations and other government entities) on how they prepared, recovered and restored their services after a disaster.

The literature on disaster recovery and resiliency should be broadened to include similar studies on other hazards, e.g., earthquakes, tsunamis and

even man-made disasters like terrorism, etc., and in other levels of local government, e.g., municipalities, provinces and regions.

The DRCI used in this study should be applied in other areas to test its reliability.

A more rigorous quantitative approach in measuring 'recovery' and 'resiliency' should be undertaken.

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**William Solecki**, Hunter College – City University of New York, New York, NY, USA

Robin Leichenko, Rutgers University, New Brunswick, NJ, USA

*Recovery from disaster and the seeds of urban transformation*

### **SUMMARY**

The transformation to sustainability requires a greater understanding of how extreme events influence local and regional development trajectories. Within the New York-New Jersey Metropolitan region, Hurricane Sandy and the immediate response to the storm have created conditions for a potential large-scale transformation with respect to settlement of the coastal zone. While the vulnerability of this region to climate change has been well-documented within the scientific literature, Sandy's impact has placed this issue into the forefront of public and private discussions about the appropriate response at every level, from individual homeowners who are contemplating whether and how to rebuild after devastating losses, to small coastal municipalities considering construction of protective engineering structures and changes in zoning laws, to the City of New York, the states of New York and New Jersey, and the federal government, which are engaging in discussions about how to better protect the region's population, property and vital infrastructure from future storms. This presentation shared preliminary results of research that entailed documentation of the ephemeral evidence of the initial phase of transition in coastal communities that were heavily impacted by Hurricane Sandy's storm surge and flooding.

## KEY LESSONS LEARNED

Half of the homeowners surveyed evacuated (average time this took was four months); of these almost all had some damage incurred and about two-thirds were uninhabitable post-Sandy.

Given that these are moderate to lower-income working class communities, i.e., lower resilience in the context of the region, property costs were an important factor in these decisions.

In terms of how people were thinking about their long-term occupancy, half said they would prepare to repair their properties to pre-Sandy conditions, whereas a smaller percentage wanted to repair, but make their property more resilient than pre-Sandy conditions.

About one-third or more sought buyouts or were looking to sell.

Most decisions were made within the first week after the storm (largest percentage over half), although many decided over a longer period of time with some still undecided over a year out.

Those who decided right away generally wanted to stay, while those who wanted the buy-out option decided this later in the process.

No significant shifts were found in social network capacity, but the study illustrates that even under conditions of stress there was some level of social network, but some felt it was declining.

A case by case analysis reveals that those with less social networking capacity were found to sell.

The higher percentage of homeowners wavering in their decision making process ultimately seeking buy-outs could be evidence of a system undergoing transition; the back and forth in decision making reflects a system of potential crisis, analogous to the change over time in the physical system.

Overall, the study reveals that there is some evidence that different conditions of resilience were present in decision making, i.e., there are reflective qualities

of systems under stress, potentially going under transition (which is the decision to buyout).

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Many government responses in the area haven't been successful with engaging with communities.

No coherent process exists of helping those with lower resource capacity.

How coastal areas can respond to these kinds of stresses (at least in the US) remains a question for the future.

## KNOWLEDGE GAPS AND NEEDS

Understanding other elements that were influencing the nature of resilience and capacity to make decisions under these conditions.

Further integration of stakeholder interviews in the analysis.

Although this study is an initial attempt to look at systems transition in the context of household decision making, further data analysis is needed to see what other conclusions and different groupings might be made, and whether a statistical analysis can be developed to illustrate the difference between influencing variables of the buy-out community and those willing to stay.



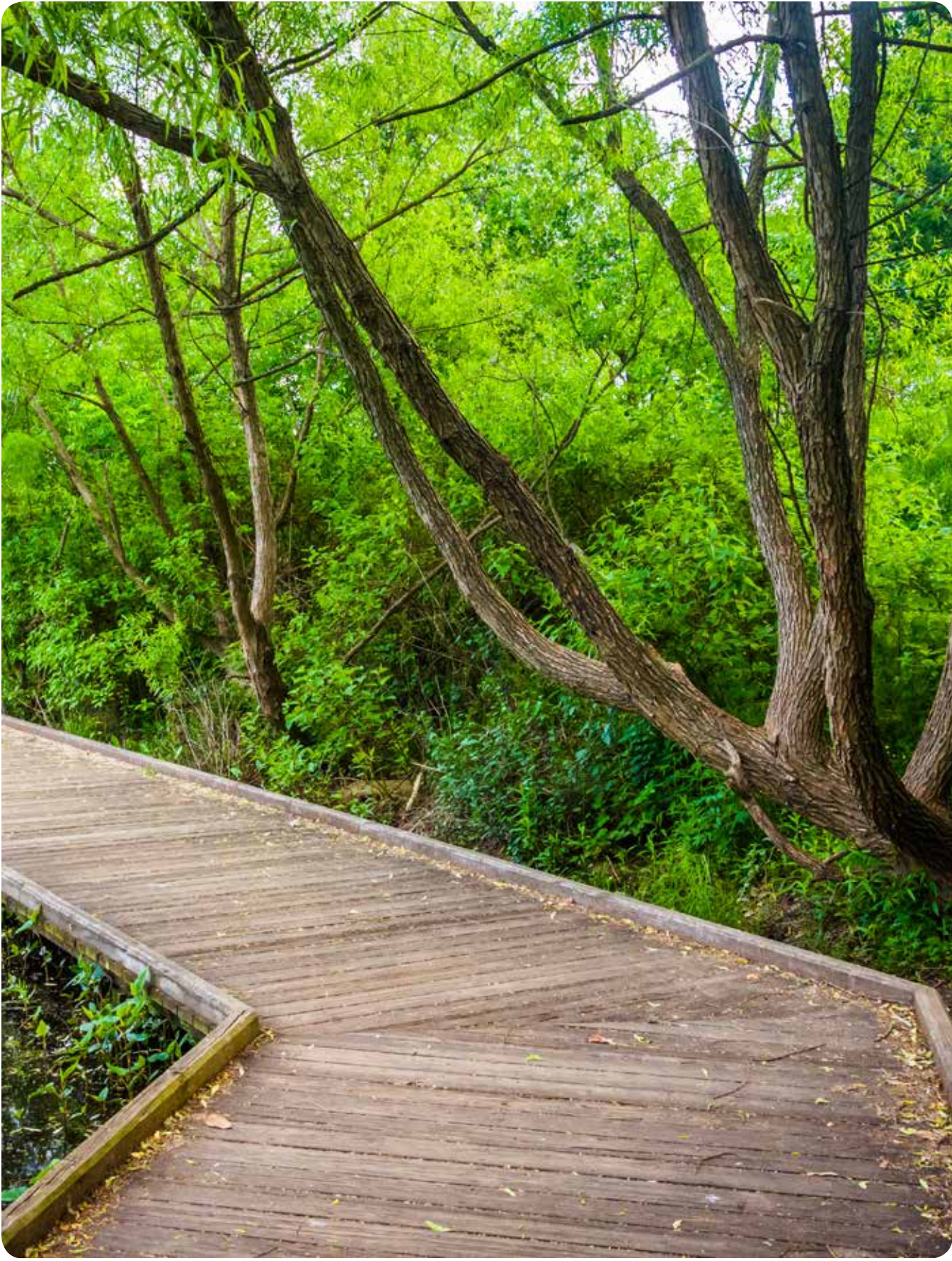


# Theme 3 Global Environmental Change, Urban Health and Well-being

Global environmental changes (including climate change and biodiversity loss) as well as urbanization pressures on the environment, e.g., air and water pollution, have multiple implications for societies. An important component of this theme is the focus on how urban areas will transition to become more resilient, connecting research on poverty, food security and ecosystem services. Global environmental change affects the pool of natural resources and ecosystem services upon which urban systems rely, and urban areas depend on vast resources for the supply of critical ecological services. These include: provisioning services, such as food, water, medicinal plants and other resources; regulating services that enhance the quality of air and soil, or that provide flood, storm and disease control; habitat or supporting services, which underpin almost all other services; and also cultural and aesthetic services. However, urbanization destroys fragile wetlands, fragments ecosystems, endangers species and threatens biodiversity, and has severe impacts on the carbon cycle through changes in the net primary productivity of affected ecosystems.

The sessions under this theme synthesized what we have learned thus far regarding the bi-directional interactions between global environmental changes and urban processes, and the effects these have on urban dwellers with respect to health and well-being. Sessions offered insight to the following questions: What have we learned in terms of how to understand, quantify and value urban ecosystem services and incorporate this knowledge into urban planning and management? What approaches currently exist for urban biodiversity conservation? How does urban design and form contribute to building healthy communities? Even more broadly, what progress has been made with respect to understanding climate change impacts on human health and vulnerability at the city scale, and preparing cities against future GEC-related risks and uncertainties?

Theme 3 represents a critical area that is yet to be extensively explored by the UGEC community, leaving fertile ground for future research and opportunity for multi- or interdisciplinary collaborations moving forward.



# Session 17 Ecosystem services in support of livable cities

## SESSION ABSTRACT

It is now widely accepted that the quality of urban life can be improved by locally generated ecosystem services. Although urban citizens are mostly dependent on global ecosystem services to meet their basic needs, they have been proposed as a tool for cities to make positive changes and enhance quality of life. For example, there is increasing recognition of the multiple ecosystem service benefits of greenspace in urban settings. From a climate adaptation perspective, living vegetation provides an important cooling function that acts to combat the urban heat island effect. In addition, urban greening also improves ecological connectivity, filters air pollutants, benefits human health and even has direct economic benefits by increasing local property prices. In recognition of these multiple values many local government authorities have begun to implement urban forest strategies with the objective of increasing canopy cover and/or the number of trees across their municipality's streetscapes and public open space.

However, whilst seen as desirable, obstacles remain to greater implementation of urban greening initiatives. This session focused on the latest research on the role of urban ecosystem services in human well-being, how ecosystem services are produced and consumed in urban areas, how programs such as urban greening and urban agriculture can benefit people in cities, and case studies on the impacts of rapid urbanization on urban ecosystem services. Going beyond a mere assessment of ecosystem benefits, the session drilled down to address some of these more complex driving forces that are currently shaping the development of new urban landscapes as well as highlight the opportunities to enhance the provision of ecosystem services in support of livable cities and the role of local government networks in

this regard. Evidence was drawn from cities across the world to provide an international perspective.

*Keywords: ecosystem services, human well-being, case studies, disservice, greenspace, climate adaptation, governance, cities*

## KEY DISCUSSION POINTS

The depopulation of Japanese cities, and others, may allow for increased ecological restoration.

There remains disagreement regarding ecosystem terminology, i.e., ecosystem services vs. ecosystem processes.

Values can affect livability and vice versa, e.g., using ecosystem services to cool a city versus using air-conditioning. Livability is something that should be agreed upon by all residents, but this is a difficult consensus to obtain, and make livability indicators are difficult to determine.

## ORGANIZERS

Darryn McEvoy, RMIT University, Melbourne, Australia

Alexei Trundle, RMIT University, Melbourne, Australia

Jun Yang, Tsinghua University, Beijing, China

## PRESENTATIONS

**Yuji Hara**, Wakayama University, Wakayama, Japan

Maki Ryu, Fransje Hooimeijer, Steffen Nijhuis, & Arjan Timmeren, Tu Delft, Delft, The Netherlands

*Agricultural land development processes differentiate wetland restoration methods toward creating an ecological network in Japan based on The Netherlands*

## SUMMARY

The current proposal by the national government of Japan for an ecological network in the Osaka city region was partially influenced by ecological networks in the Netherlands. However, the government specified the physical spatial pattern of these wetland restoration sites without considering a historical geographic viewpoint for both Japan and the Netherlands. On the field project scale, there are similarities in wetland restoration processes and measures in the coastal reclaimed land (unused industrial sites) between Japan (e.g., Osaka Nankou Bird Sanctuary) and the Netherlands (e.g., Oostvaardersplassen). On the other hand, there are differences in wetland restoration measures in the farmlands between Japan (the restoration of abandoned rice paddy fields) and the Netherlands (e.g., Tiengemeten, the conversion of dry fields to natural wetlands) that must be considered before any major projects are undertaken.

## KEY LESSONS LEARNED

Regional considerations and historical geography perspectives are very important when ecological networks and restoration projects are being planned.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Although 'good' planning practices of foreign countries can be valuable in developing ecological networks/nature restorations in one's own country, directly importing those ideas and practices without any consideration of regional conditions can be problematic.

## KNOWLEDGE GAPS AND NEEDS

The potential for vegetation recovery, biodiversity baseline, and local variation of resilience at the regional level are future research needs.

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**Alessandro Ossola**, Fiona J. Christie, & Stephen J. Livesley, University Of Melbourne, Melbourne, Australia

Amy C. Hahs, Australian Research Centre For Urban Ecology, Royal Botanic Gardens Melbourne, Melbourne, Australia

Michael A. Nash, South Australian Research And Development Institute, Adelaide, Australia

*The simplification of urban ecosystems structure affects soil processes and soil biodiversity*

## SUMMARY

This study aimed to understand the effect of the simplification of urban ecosystem structure on soil processes, namely litter decomposition and comminution, and the soil organisms involved in these processes. The study addressed the following research questions: 1) Is the simplification of the structure of urban ecosystems affecting soil processes? 2) How does the simplification of the structure affect the microclimate of the surface decomposition environment?; and, 3) Does the variation in soil processes correlate with a variation in soil biodiversity? This research provides the first evidence that the simplification of urban ecosystem structure exerts a control on microclimate, habitat and resources for soil organisms, and consequently the dependent soil processes.

## KEY LESSONS LEARNED

The evaluation of ecosystem services and benefits provided by urban ecosystems must be based on the quantification of the underlying ecological processes and functions.

The simplification of urban ecosystems affects key soil processes and the relative ecosystem services (e.g., carbon sequestration, soil health, etc.).

Micro-climate and soil organisms are also affected by urban ecosystem simplification.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Humans alter the structure of the urban ecosystems in which they live and interact based on management practices, aesthetics and socio-economic values.

Increasing the structural complexity of urban ecosystems may improve soil processes and the relative benefits, and possibly the overall resilience of these systems to future environmental changes.

Urban managers should liaise with citizens, ecologists, designers and architects to plan, design and maintain high-complexity urban ecosystems with enhanced ecosystem services.

### KNOWLEDGE GAPS AND NEEDS

There is a need to understand whether urban ecosystem simplification exerts a similar control on soil processes and biodiversity in different climates, soil types and socio-economic contexts.

There is a need for inclusion of a temporal dimension in the evaluation of ecosystem legacies.

The interactions between urban ecosystem complexity and other drivers of change (e.g., climate change) need further evaluation.

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Jun Yang, Tsinghua University, Beijing, China

*Building the linkages among urbanization, ecosystem services and human well-being*

### SUMMARY

In this study, an analysis of the impacts of rapid urbanization on four types of ecosystem services (carbon storage, flood control, biodiversity and food production) was performed in 30 major Chinese cities between 1990 and 2010. The results show that rapid urbanization has caused significant changes in both the magnitude and distribution of ecosystem services in those cities. All cities have experienced deterioration in ecosystem services during urbanization.

The current urbanization policy, which has led to the conversion of land use/cover with high values of ecosystem services to land use/cover with low value ecosystem services, must be revised to prevent the further loss of ecosystem services. Land use/cover change can serve as a useful indicator to link urbanization, ecosystem services and human well-being at the regional scale.

### KEY LESSONS LEARNED

Land use/land change is an easy-to-use indicator to link urbanization, ecosystem services and human

well-being, but the spatial-temporal dynamics must be fully accounted.

Urbanization does not always reduce the total supply of ecosystem services, but can cause trade-offs; for example, in Beijing, carbon storage has increased by 64% and stormwater runoff has been reduced by 29%, but natural habitat and food production have both decreased.

### POLICY/PRACTICE IMPLICATIONS OF RESEARCH

In order to better incorporate urban ecosystem services into policy making, information on dynamics, trade-offs and alternative ecosystem services must be included in assessments.

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Alexei Trundle & Darryn McEvoy, RMIT University, Melbourne, Australia

*Resilience, the optimization paradox and green infrastructure: Ecosystem-based adaptation lessons from the land of droughts and flooding rains*

### SUMMARY

This presentation examined the interface between the complex, variable and inter-related effects of climate change and the equally multi-faceted, co-beneficial implementation of Urban Green Infrastructure (UGI). Building on findings from a recently-completed assessment of the potential for application of this ecosystem-based adaptation approach in Melbourne, three arguments are put forward.

Firstly, to avoid the 'optimization paradox' evident in the recent southeast Australian experience, a system-wide approach to urban adaptation and development – encompassing multiple thresholds and stressors – is necessary. Secondly, adaptation options where benefits, spatial applicability and governance are equally complex emerge as being central to enhancing urban resilience. Finally, UGI reductions in Melbourne concurrent to UGI expansion across Europe, North America and Asia demonstrates the crucial role of the availability, variability and applicability of water in the

application and management of urban ecosystem-based adaptation strategies.

### **KEY LESSONS LEARNED**

Urbanization is a dynamic process, which interacts with climate change as well as local climatic conditions. However a more fundamental function is the interaction between the human behavioral and socio-cultural patterns that underpin urbanization, and the surrounding environment.

Strategies to improve the urbanization process (whether through reducing a city's global footprint, or improving livability) require an understanding of the urban system's boundaries, limits and externalities.

'Livability' reflects the subjective values associated with perceptions of what an urban environment should contain as well as how it should interact with its inhabitants.

### **POLICY/PRACTICE IMPLICATIONS OF RESEARCH**

Linking benefits and costs to stakeholders and sectors is central to creating change and understanding the urban system.

Stakeholder 'definitions' of key concepts can have long-term and wide-reaching implications.

Understanding and integrating both climatic and non-climate shifts spatially and dynamically is central to measuring vulnerability and risk.



# Session 20 Urban health and global environmental change: Interdisciplinary perspectives

## SESSION ABSTRACT

The growth of cities needs to be carefully managed if urbanization is to enhance, not threaten, human health and well-being. The increasing complexity of urban systems had led to the need for practical systems approaches. Such approaches range from simple 'systems-thinking' methods, through conceptual models, to quantitative dynamic analyses. In practice, all these approaches are useful. A systems-thinking approach is recommended as the first step in implementing the systems analysis proposed in the Urban Health programme. Such an approach can identify cross-sector links (in government, professional disciplines, and geographic locations) and reveal the feedback interactions between sectors and disciplines. It can also contribute to an understanding of how feedback influences policy outcomes. A systems approach stresses the need to study cross-sector feedback interactions. This is essential to avoid common system effects such as 'policy resistance', and other unwanted and unexpected outcomes of management actions.

Human health is identified by the International Council for Science (ICSU) as a new research priority. ICSU's 'Health and Well-Being in the Changing Urban Environment: A Systems Analysis Approach (hereinafter Urban Health) programme is a 10-year interdisciplinary research effort with the aim to generate policy-relevant knowledge that will improve health status, reduce health inequalities and enhance the well-being of urban dwellers. It will focus on the integration of natural, social, medical and engineering sciences using systems approaches to address the complexity of urban issues and their influence on health. Urban health is a particular concern in the developing world, where urbanization is rapid.

The session introduced a systems approach suitable for studying urban health issues called Collaborative Conceptual Modelling (CCM) and included concise presentations of urban health issues related to global environmental changes from interdisciplinary approaches.

*Keywords: urban health, climate change, heat, epidemiology, healthy cities, systems approach, environmental change and health, urban planning and health*

## KEY DISCUSSION POINTS

Urban planners and decisionmakers need to play a stronger role in improving human health in cities.

Knowledge of how to strengthen this role requires co-production, which, in turn, requires cross-sector collaboration.

Co-production and co-design of knowledge require trust between all parties, and attention to the challenge of developing shared understanding. This calls for vigilance in detecting opportunities to improve cross-sectoral communication.

Robust policies require a feedback-systems approach. System dynamics modelling can help collaborative groups improve their understanding of possible policy impacts. It is important, however, to keep the models as simple as possible, if they are to influence the thinking of urban planners and decisionmakers.

System archetypes are examples of simple models that can improve systems thinking. They are feedback structures that occur in many contexts and have characteristic behaviors. They can help a collaborative group identify leverage points for effective change.



## ORGANIZERS

Shih-Chun Candice Lung, Academia Sinica, Taipei, Taiwan

## PRESENTATIONS

Nordin Hasan, ICSU Regional Office For Asia And The Pacific, Kuala Lumpur, Malaysia

*Developing an urban health research programme using the systems approach*

## SUMMARY

There is an urgent need to initiate urban health and well-being programs that promote more holistic evidence-based outlooks for decision-making systems and approaches at the local and regional levels. Recognition of this imperative led the International Council for Science (ICSU) to promote research that does more than pay attention to distal factors and cross-scale influences. It stresses the need for studies of urban dynamics, including the effects of feedbacks and human-environment interactions. The ICSU Regional Office for Asia and the Pacific (ROAP) developed in 2011 its Science Plan, 'Health and Well-Being in the Changing Urban Environment: A Systems Approach.' A number of pilot projects have been initiated, each of which aims to investigate the challenges and benefits of taking a systems approach to population health in major cities in the region.

## KEY LESSONS LEARNED

Developing a multidisciplinary research idea into a viable research project involves a great deal of effort and perseverance.

There is a need for clear articulation of a research approach and methodology. Using the systems approach, researchers from several disciplines had to be first coached in the methodologies available to collaboratively conceptualize the relationships of all the major determinants of urban health and well-being in a changing environment.

Once conceptual models are more or less understood and agreed upon, various research questions must be prioritized in order to develop a coherent proposal to attract funding.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

This research is designed collaboratively with the participation of scientific, technical and managerial staff in a designated urban area. This co-design of research ensures that the science questions posed in the project will produce answers that can be applied to urban policymakers and managers.

Policy relevance of the research is ensured because the design is collaborative, and the scientists in the research teams understand the need to be policy- and practice-relevant. The institutional challenge is to ensure the participation of city managers in scientific research design, and to implement the research findings even if it means overturning earlier decisions or replacing old policies with newly redesigned policies.

## KNOWLEDGE GAPS AND NEEDS

Groups engaged in the co-design of multidisciplinary collaborative research need to participate in capacity-building workshops to understand systems approaches. The tendency is for established research groups/teams to do more of the same using familiar methods.

New methods for data analysis, data and information integration from several fields and multiple disciplines are needed, e.g., quantitative methods in one field may not be applicable in another.

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**Shih-Chun Candice Lung**, Academia Sinica, Taipei, Taiwan

Pam Pei-Chang Wen, Chung-Hua Institution for Economic Research, Taipei, Taiwan

I.C. Tsai & Jen-Ping Chen, National Taiwan University, Taipei, Taiwan

*Using a systems approach to design a green transportation system for better urban health under climate change*

## **SUMMARY**

The main focus was to present a cross-disciplinary integrated research framework for using a systems approach linking transportation, air quality (and climate) and urban health. Different green transportation alternatives have various degrees of transportation function. To tackle the challenge of complexity among different sectors, emphasis is placed on the feedback loops among green transportation, air quality, climate and urban health, according to Collaborative Conceptual Modelling (CCM). Accordingly, a conceptual tool kit was constructed to display the interrelationships among different sectors and was first utilized in Taiwan.

## **KEY LESSONS LEARNED**

The systems approach is a key methodology that can be used in multidisciplinary works, such as linking the research of health-related issues to global environmental change studies and urban planning. The essential lesson learned from this work is to demonstrate the importance of using such a methodology to streamline modeling works in different disciplines at the research-planning stage. This approach can assist the successful delivery of research outcomes in each discipline as well as support an integrated research output useful for tackling challenges in urban planning.

## **POLICY/PRACTICE IMPLICATIONS OF RESEARCH**

It is important for policymakers to visualize the potential benefits among different policy options before making decisions.

Decisionmakers can be better informed of the potential co-benefits of green transportation alternatives with respect to environmental impacts and health risks under current and future climate change scenarios.

Actions can be taken to formulate plans for future transportation infrastructure that would lead to better urban health under climate change.

## **KNOWLEDGE GAPS AND NEEDS**

More systems research is needed that connects different disciplines and makes links with decisionmaking processes.

Multidisciplinary research is challenging since different disciplines have their own jargon. Collaborative Conceptual Modelling (CCM) has the potential to focus on the overlapping linkages among different disciplines with a common language; CCM should be further promoted, in order to facilitate trans-disciplinary research under Future Earth.

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Katrina Proust, The Australian National University, Canberra, Australia

*History and the feedback dynamics of technology choice*

## **SUMMARY**

This study provides an example of the use of Collaborative Conceptual Modelling (CCM). It demonstrates how techniques from the practice of history can reveal important aspects of feedback dynamics. Installing air conditioning immediately allows people to control their living environment. Hence, communities have been able to inhabit areas of extreme temperature and humidity that would be otherwise unsuitable for permanent settlements. However, this dependence results in a loss of adaptive capacity. The use of air conditioning in domestic dwellings reduces an individual's ability to acclimatize to temperature and humidity changes. When serious heatwaves occur and dependence on air conditioning is highest the power-generating system is stretched to capacity. This situation increases the risk of power failures and the number of cases of thermal stress in the community. It has important implications for climate change adaptation in urban settings.

## **KEY LESSONS LEARNED**

Historical studies can provide dynamically relevant data to support system analysis. Such studies are

essential in attempts to see strings of events as evolving patterns.

We live in a world dominated by feedbacks, where urban systems are becoming more complex. We need to be alert to feedback effects, especially cross-sector feedback.

### **POLICY/PRACTICE IMPLICATIONS OF RESEARCH**

The unintended outcomes of urban policy are usually delayed and unwanted. Because they are delayed, these outcomes are often erroneously attributed to proximal events. To anticipate unwanted outcomes, urban policymakers need to imagine a much wider system with its many links.

Historical-dynamic studies can help to better understand systems and to reduce policy surprise.



# Session 39 Urbanization, biodiversity and ecosystem services

## SESSION ABSTRACT

The interactions between urban areas and populations, biodiversity and ecosystem services are becoming increasingly diverse as urban areas expand and transform habitats. Both direct and indirect impacts of this growth on biodiversity will be significant. The direct impacts are land use change, introduction of invasive species and change of local biogeochemical cycles. The indirect urban impacts are activities that occur in urban areas that affect biodiversity, such as consumption demands for food, water, timber and related natural resources located outside of or far from the hinterlands of urban areas. As the world's population increasingly locates in urban areas, human activities including consumption demands will also concentrate in these locations.

Despite these negative trends, cities may also include opportunities for biodiversity. For example, given population growth, concentrating land use change in and around urban areas can help save habitat. A generous estimate of current urban land use suggests that it accounts for approximately 3% of total terrestrial area. However, regional and global studies that study the likely impacts of urban expansion on biodiversity and ecosystem services are still in their infancy. While invaluable to developing our understanding between urbanization and biodiversity conservation at specific localities, case-based studies from the developing world are relatively few, insufficient to generate a comprehensive outlook. More analyses are needed, in particular, those that focus on interactive effects of factors that drive urbanization in relation to biodiversity and ecosystem services. The session provided a survey of the state of the knowledge on the interactions of urbanization with biodiversity and ecosystem services at local, regional and global scales and included studies that

explore current and future relationships between urbanization and biodiversity.

*Keywords: biodiversity, ecosystem services, habitat conservation, urban expansion, urban ecology*

## KEY DISCUSSION POINTS

The relationship between people, ecosystems, and biodiversity is multifaceted and complex. Important issues regarding these relationships include:

How do the individuals interact with those ecosystems in or near which they live? What terms do we use to discuss these interactions? Are they ecosystem 'services' or are they processes? This points to the focus of study, whether it is from the anthropocentric view or from a naturalistic point of view.

How are ecosystems and biodiversity valued by city residents, e.g., beauty, avenues for social engagement, environmental sustainability, enhancing quality of life through improvements in air quality, reductions in pollution, etc.? This also translates into issues of livability. What is required for ensuring that (urban) sustainability is not only the valuation of the local/regional ecosystems, but also those distant ecosystems on which their city may have an indirect impact in the form of consumption of resources?

How can the political and planning environments of a city enhance or deteriorate biodiversity and ecosystem services? Often cities view the enhancement of these aspects of the environment not through sustainability, but through the co-benefits associated with their enhancement, e.g., what are the trade-offs of protecting ecosystems rather than utilizing them for other purposes? An example of these would be deforestation near rapidly urbanizing cities. More often than not, the goals and priorities of local residents do not coincide with those

at the national or international levels. This leads to communication problems and conflicts across different levels of governance.

## ORGANIZERS

Burak Güneralp, Texas A&M University, College Station, TX, USA

Peter Marcotullio, Hunter College – City University of New York, New York, NY, USA

Karen Seto, Yale University, New Haven, CT, USA

## PRESENTATIONS

**Peter Marcotullio** & Carson Farmer, Hunter College – City University of New York, New York, NY, USA

*Global urbanization-biodiversity tensions to the year 2100*

### SUMMARY

A simple model was used to project spatial human population every decade from 2000 to 2100. It was focused on urban growth, as most increases in population over the coming century will be within the world's cities. A series of biodiversity layers was laid over the areas of population growth to identify potential locations of urban-biodiversity tension, using three types of analyses to identify these tensions. In the first analysis, the distribution of human population and biodiversity along the latitudinal gradient and in different ecosystems were examined and compared. In a second analysis, there was an examination of growth of population as specific locations (i.e., those with high endemism, location in or near biodiversity hotspots and locations in or close to protected areas, such as parks). Third, areas of both high biodiversity richness and high population density were identified.

### KEY LESSONS LEARNED

The analysis suggests that given the spatial distribution of population and the increasing urbanization of the planet, the number of areas of urban-biodiversity tension demonstrate significant increases throughout the century.

These results, given the simple methods to project population, suggest more research and model development is needed to identify conservation strategies and could be applied immediately to help reduce future tensions.

## KNOWLEDGE GAPS AND NEEDS

The development of a process of projecting urbanization to 2050 and identifying locations of human-biodiversity tension.

Refinement of techniques and the ability to use them on a global geography for all countries to 2050 and possibly 2100.

The further use of object-oriented methods to develop more complicated models of urbanization, including land use change, economics components, etc., along with a larger set of biodiversity data.

Robert McDonald, The Nature Conservancy, Arlington, VA, USA

*The global sustainability of urban water sources*

### SUMMARY

Urban growth is increasing the demand for freshwater resources; yet, surprisingly, the water sources of the world's large cities have never been globally assessed, hampering efforts to assess the distribution and causes of urban water stress. This research team conducted the first global survey of large cities' water sources and then evaluated the sustainability of those cities' water supplies in terms of water quantity and water quality. It shows that previous global hydrologic models that ignored urban water infrastructure significantly overestimated urban water stress. Large cities obtain 78±3% of their water from surface sources, some of which are far away: cumulatively, large cities moved 504 billion liters a day a distance of 27,000±3,800 km, and the upstream contributing area of urban water sources is 41% of the global land surface. Despite this infrastructure, one in four cities, containing \$4.8±0.7 trillion in economic activity, remain water stressed due to geographical and financial limitations. The strategic management of

these cities' water sources is therefore important for the future of the global economy.

### **POLICY/PRACTICE IMPLICATIONS**

The work on quantifying the dependence of cities on ecosystem services is motivated by a desire to increase investment by water utilities in source watershed conservation. However, even if there is a clear economic rationale for such an investment (i.e., green infrastructure is cheaper than the grey infrastructure alternative), there are numerous institutional barriers to such investment. Municipal utilities often do not have the jurisdiction to invest in conservation outside their boundaries; negotiating land transactions with multiple landowners may simply have too high a transaction cost; and in large basins with multiple water users, collective action is needed. One way out of these challenges is having a formal 'watershed utility' that can serve to bring water users and landowners together and pool funds for wise stewardship of habitat that generates crucial ecosystem services.

### **KNOWLEDGE GAPS AND NEEDS**

While the biophysical data (slope, land cover, ecosystem function) is fairly well characterized, and the city water map begins to characterize the grey infrastructure (reservoirs, canals, etc.), it is still very difficult to know much about the social or institutional context for multiple cities. Ideally, this kind of information would be available to answer questions like:

Are certain institutional governance structures more likely to lead to wise watershed management?

Has investment in source watershed conservation been greater in some institutional contexts than others?

For trans-boundary urban source watersheds, has that lead to conflict or collaboration between cities?

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Burak Güneralp, Texas A&M University, College Station, TX, USA

Karen C. Seto, Yale University, New Haven, CT, USA

*Futures of global urban expansion: Uncertainties and implications for biodiversity conservation*

### **SUMMARY**

Urbanization will place significant pressures on biodiversity across the world. However, there are large uncertainties in the amount and location of future urbanization, particularly urban land expansion. Presented is a global analysis of urban extent circa 2000 and probabilistic forecasts of urban expansion for 2030 near protected areas and in biodiversity hotspots. It is estimated that the amount of urban land within 50 km of all protected area boundaries will increase from 450,000 km<sup>2</sup> circa 2000 to 1,440,000 km<sup>2</sup> in 2030. Uncertainties in the forecasts of the amount and location of urban land expansion reflect uncertainties in their underlying drivers including urban population and economic growth. The forecasts point to the need to reconcile urban development and biodiversity conservation strategies.

### **KEY LESSONS LEARNED**

The greatest increases in urban land around the protected areas (PAs) will take place in China, with the amount of urban land increasing as much as 3-7 times between 2000 and 2030.

### **POLICY/PRACTICE IMPLICATIONS**

The varying levels of uncertainty in future urban expansion across different regions of the world also have important policy implications, especially considering these regions also differ in terms of their development levels. The most critical implication, however, is the brief window of opportunity in front of us for the next decade or two to develop and implement more robust urbanization strategies that explicitly consider biodiversity conservation.

For many regions, how urbanization will affect PAs will depend on the effectiveness and synergy of land use, conservation and urbanization policies. Even in developed countries, the issue of effective governance of lands near PAs for preservation of ecosystem

functioning and conservation of biodiversity remain unresolved. In the U.S., having a formal conservation mechanism that would allow for the management of lands around PAs to safeguard them against unwanted influences remains unaccomplished due to various political and cultural reasons. One is the fragmented jurisdictions of several bodies, while another is the lack of coordination between agencies and actors responsible for governing PAs and the lands around PAs, respectively.

In South America, mid-latitude Africa, India and Southeast Asia, the developing regions with the largest forecasted magnitudes of urban expansion near PAs after China, effective governance and management of PAs and surrounding lands will likely be challenging due to weak institutional capacity and lack of adequate financial resources. This challenge is especially acute for mid-latitude Africa that is forecasted to experience the greatest proportional increases in urban land. For example, according to our forecasts, the urban land within 50 km of Kilimanjaro National Park is expected to increase primarily due to rapid urbanization in and around Moshi, Tanzania—at the foot of iconic Mount Kilimanjaro, part of the Eastern Afromontane hotspot.

### KNOWLEDGE GAPS AND NEEDS

Findings highlight the need to consider future urban expansion and associated uncertainties in conservation planning. They also point to the need for more detailed national or regional analyses. This is especially the case for regions with substantial forecasted urban expansion near PAs and in biodiversity hotspots (i.e., China, mid-latitude Africa, South America, Western Asia and Southeast Asia). These regions have arguably the most at stake in terms of direct impacts of urban expansion on biodiversity.

Methodologically, there are inherent limitations to the urban expansion forecasts used in this study. Factors that were not included in the study, but may significantly influence regional and local urban land expansion include climatic factors, agricultural

productivity, land use policies, international capital flows and infrastructure investment.

In Africa, Latin America and Asia, the informal sector, which is not included in official GDP estimates, constitutes a substantial share of the overall economic growth. In addition, urban growth is often accompanied by construction of transportation infrastructure, which may have considerable impact on the spatial pattern of urban expansion. However, the model assumes a static road network ignoring potential construction of new roads. In addition, the model forecasts do not differentiate among various urban land uses or between formal and informal growth.

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Thomas Elmqvist, Stockholm University, Stockholm, Sweden

*Analyzing urban resilience and sustainability through a social-technological-ecological system approach: Lessons from The Cities and Biodiversity Outlook Project*

### SUMMARY

The Cities and Biodiversity (CBO) project explored the social-ecological foundation of cities and their sustainability. A social-technological approach has, up until now, been a traditional way of analyzing urban complexity, causing many to struggle with defining exactly what is meant by a 'city'. As highlighted in the CBO, the rapidly emerging framework of viewing cities as complex social-ecological systems puts the human dependence on the biosphere on the urban agenda. Although the social-technological and social-ecological approaches will continue to be important in the urban sustainability discourse, an urban ecological-technological approach may be increasingly important in the future. This approach represents how living systems may be integrated in built systems and necessary to succeed in enhancing human well-being in urban areas in the face of new and complex challenges such as climate change, and enhancing food and water security in an increasingly changing and globalized world.



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Harini Nagendra, Azim Premji University, Bangalore, India

*The cooperative governance of urban commons*

## **SUMMARY**

Practical experience with community governance in the context of Bangalore's lakes has strongly highlighted the role for dialogue between communities and city government in providing the conditions conducive for effective co-management. Such initiatives are few and far between in Bangalore and indeed in most fast growing cities across the world. Our only hope for scaling up such action is through interdisciplinary education that crosses boundaries, engaging with students, local communities, policy makers and private actors, joined in the common goal of seeking equitable pathways towards greater urban sustainability. Engaging with problems of sustainability in an equitable, fair and just manner will require the fresh perspectives engendered by such discussion.

## **KEY LESSONS LEARNED**

Urban ecological commons will be critical for sustainability in the cities of the future.

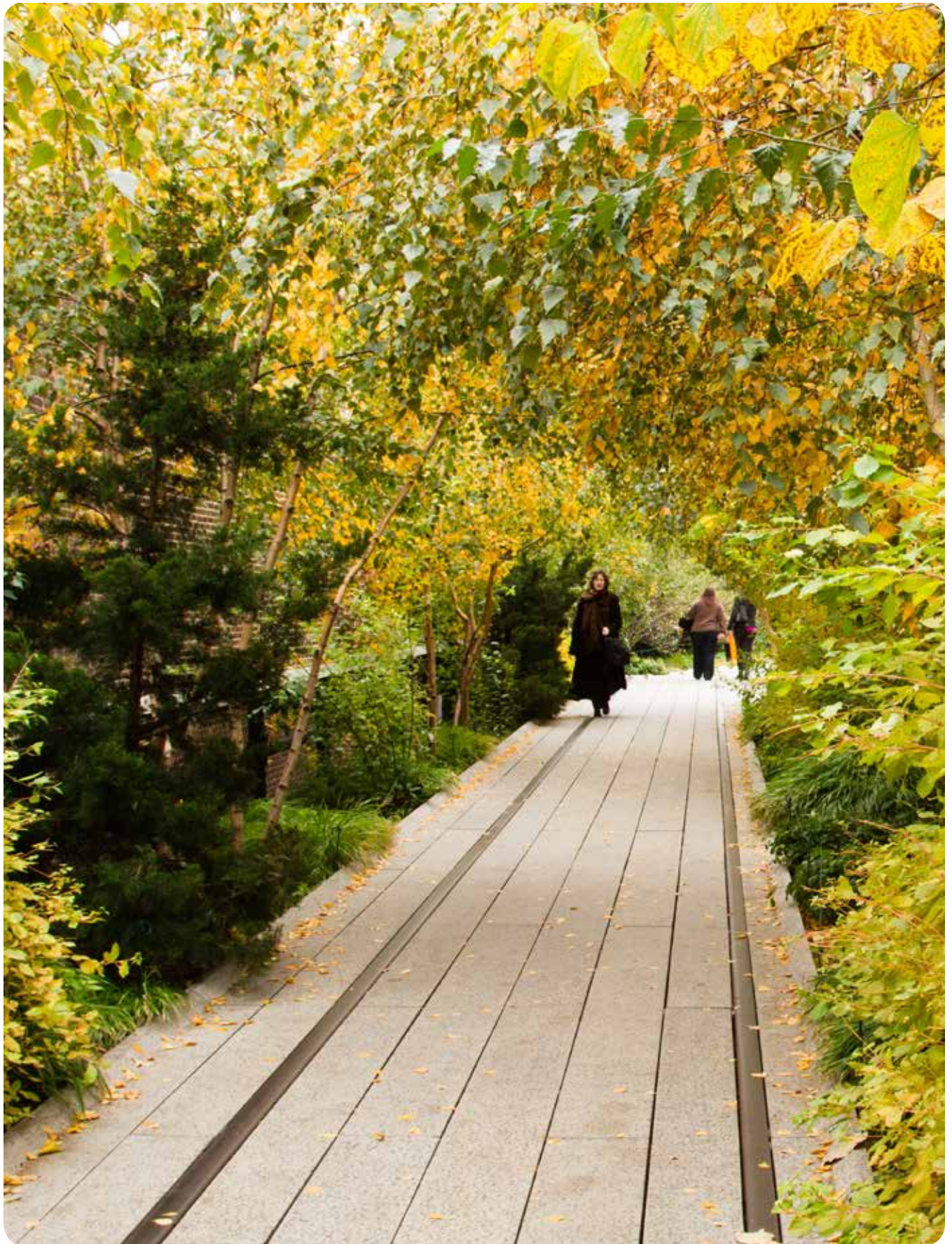
Commons (vs. public, or private ecosystems) provide the greatest opportunities for resilience of the urban poor, migrants, traditional livelihoods and women.

Social and ecological outcomes are not always congruent.

There is a need to enlarge our discussion of models of urban governance to include a third alternative to the commonly espoused twin pillars of private and government administration, i.e., that of the community.

## **POLICY/PRACTICE IMPLICATIONS**

Multi-level collaborations between local community groups, civil society actors and government administration are essential for the effective, equitable and sustainable governance of natural resources.



# Session 42 Resilience in the urban landscape: Improving human well-being

## SESSION ABSTRACT

Cities are habitat for people. They are ecosystems of built and natural elements, of flows and socio-ecological processes, of designed and wild nature, of people, communities and civic spaces between buildings. Are we designing our urban landscape with key socio-ecological principles and knowledge in mind? Cities are social-ecological spaces and must be thought of as such if they are to be designed for resilience, sustainability and livability. The session combined theory and practice, inductive and deductive work, to offer real world examples and insights. It reflected the fundamentally multi-disciplinary nature of socio-environmental research in urban spaces and addressed their essential relevance to city building by gathering speakers that span the design-biophysical, natural science-social science continuum. The session provoked further exploration into how design and multidisciplinary science can work together in new ways to create cities that work better for people, for nature and for the future.

Some ideas explored (not an exhaustive list):

What do people want from their outdoor urban spaces? What do they need?

Movement toward a design ethos grounded in the sciences of ecology and sociology.

Designing spaces that build on local ecology, local patterns and native species.

Urban nature and multi-functional ecosystem services that contribute to resilience, sustainability and livability.

Cultivating better dialog between design, science and city management.

Future research that helps to better incorporate resilience perspectives into urban planning.

*Keywords: ecology, well-being, urbanization, nature*

## KEY DISCUSSION POINTS

The sustainability objectives of one city can undermine the sustainability objectives of other cities. This involves issues of justice and equity, which are fundamental to sustainability. We need to think about systems of cities rather than individual cities.

Questions of scale and boundaries, which are often viewed as finite by local government officials, are often underestimated. The rural and peri-urban areas have as much to do with urbanization as the cities themselves.

Parks are not necessarily the panacea that they are made out to be, especially in areas where there is a danger in using them, and where maintenance of the park becomes prohibitive.

What does it mean that nature is not a revenue-generating service in the urban context? It may not be revenue-generating, but it can be revenue-saving, e.g., mental and physical benefits of ecosystem services help save in healthcare costs.

In certain areas, the bulk of green space is private space, e.g., domestic gardens in middle- and high-income homes. This brings up questions of access and equality.

Increases in city density can cause the loss of ecosystem services and biodiversity, for which is almost never compensated.

Are we trying to change the value of green spaces, or are we trying to change the values of the people who live near those spaces and, therefore, increase the value with which those people view the green spaces?

Children often bear the brunt of injustice of urbanization and are unable to voice their experiences.

## ORGANIZERS

Thomas Elmqvist, Stockholm Resilience Centre, Stockholm, Sweden

David Maddox, The Nature of Cities, New York, NY, USA

Harini Nagendra, Azim Premji University, Bangalore, India

## PRESENTATIONS

Timon McPhearson, The New School, New York, NY, USA

*Taking advantage of big data and the internet of things to advance the social-ecological study of urban system complexity*

### SUMMARY

This presentation discussed the use of data streams to build the science that can inform policy in urban areas. It gives an overview of the NYC social-ecological system, including how New York City utilizes ecosystem services and what ecosystem services are provided by the city (more specifically, ecosystem services provided by vacant lots, the social needs of surrounding residents and the extent to which they are provided). The data from social media outlets, such as Twitter and Flickr, can be utilized to answer many of these social questions. Residents are constantly reporting their perceptions, values and attitude about spaces, whether it is through the sharing of photos, status updates, or emoticons. These sources of data represent a new way forward in advancing the study of complex urban systems.

### POLICY/PRACTICE IMPLICATIONS OF RESEARCH

There is a massive amount of information about the complexity of urban systems that we can use to inform policy and planning

Planners can use this data and its characteristics to understand why people are using some resources and not others. This will help planners to better focus on what they should and should not develop.

## KNOWLEDGE GAPS AND NEEDS

Adding social demographic data is beneficial to understand the motivations and backgrounds of the people who are utilizing public spaces.

Harini Nagendra, Azim Premji University, Bangalore, India

*What is a good 'urban'? Who decides? Stories around a lost lake in Bangalore*

### SUMMARY

This presentation gave a historical account of Sampangi Lake in Bangalore (now gone and replaced with a polo field) including how the lake was lost, oral histories of the lake, the relationship between the actors involved in the lake's history, how the lake was utilized and how the case of this lake informs us about modern lakes and our views of resources in urban areas.

### KEY LESSONS LEARNED

Technical solutions to social ecological problems are very popular, but do not always work.

When considering urban planning and issues of development, one must look at the normative framing.

Social justice and environmental sustainability do not always go hand-in-hand.

Shuaib Lwasa, Makerere University, Kampala, Uganda

*Resilience in the urban landscapes: improving well-being in rapidly urbanizing Africa*

### SUMMARY

This presentation dealt with human well-being and how landscapes are transforming in Africa, especially how rapid urbanization is affecting demographic,

economic, technological and ecological transitions. How is the urban transition affecting the ecological transition and vice versa?

### KEY LESSONS LEARNED

Characteristics of a good city include: easy and safe transportation; promotion of social-economic opportunities; and utilization of local resources to promote health. Evidence that these have been achieved include reduced social and political tensions, a healthier population, an efficient economy and more efficient use of time among citizens.

### KNOWLEDGE GAPS AND NEEDS

A socio-cultural valuation for local land use that transcends economic value.

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Keitaro Ito, Kyushu Institute Of Technology,  
Kitakyushu, Japan

*Resilience in the urban landscape: For sustainability we need collaborative nature restoration*

### SUMMARY

Three projects in Japan have enhanced the local ecological networks and provision for ecological education, especially for children. The first project involved the restoration of a riverbank next to a dam. The second was the restoration of a city park where children were asked to participate in its design and construction. The final project converted a play yard at an elementary school in Fukuoka into an active biotope. Again, children were asked to take part in its design and construction. Research has found that the amount of types of play increased; about 170 kinds of play were observed in this converted school yard.

### KEY LESSONS LEARNED

We must establish practical methods of people's participation and collaboration for designing urban nature based on biodiversity and ecological design.

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David Maddox, The Nature Of Cities, New York, NY,  
USA

*Resilience in the urban landscape: Improving human well-being*

### SUMMARY

This presentation discussed who gets to define the 'good' city and the discovery of how people talk about what makes good and useful outdoor spaces. Examples of citizen participation, both direct and indirect, include the development of a linear park in Buenos Aires and the use of 311 in New York City to request street trees. Equality of access to parks, especially linear parks, needs to increase world-wide.

### KEY LESSONS LEARNED

We want our cities to be livable, sustainable and resilient. There are nature-based solutions that involve all three.

We need to ask residents how they want to use 'outdoor spaces'. Communication of ideas around nature and ecosystem services need to be framed in such a way that the ideas can reach the most people with the least amount of difficulty and confusion.

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Thomas Elmqvist, Stockholm University, Stockholm,  
Sweden

*What Is A Good City In The Anthropocene?*

### SUMMARY

In the context of livable cities, not only should the question, 'What is a good city?' be asked, but also the question, 'What is a good city in the Anthropocene?' Instead of talking about the 'good city', we should talk about 'good urbanization'.



# Session 64 Influence on urban health in the Global South: Identifying the challenges

## SESSION ABSTRACT

Global change is affecting urban health through direct and indirect pathways. The fast growing urban agglomerations of the Global South often witness a severe deterioration of ecosystems, living conditions and consequently human health. Demographic shifts, health transitions and the adequate response of health systems to these problems pose severe challenges. This session mapped out major determinants shaping the health vulnerabilities of urban populations in the Global South and link these to global change as one of the root causes.

Determinants of health can be broadly categorized as social and environmental. A third dimension of health pertains to health systems as they respond to emerging health transitions. For the urban agglomerations in the South, determinants such as poverty, predominance of informal settlements, the deterioration of air and water quality, degraded ecosystems and associated health services, growing inequities and vulnerabilities complicate and create health challenges. Poor health services (public and private) and restricted access for the poor and other vulnerable groups further sharpens the prevailing health inequities. Understanding the major influences of urban health and providing solutions for generating the necessary knowledge for decisionmakers was a major aim of this session.

*Keywords: health, Global South, transitions, determinants*

## KEY DISCUSSION POINTS

Urban spaces in the Global South are unhealthy places due to the process of the rapid urbanization, the lack of skills and resources of local authorities, and external influences like global change.

We need a differentiation of vulnerability within cities to know who needs to be targeted by public health interventions, i.e., who is the most vulnerable.

Health costs are rising because of ecological degradation, exposure to hazards, and lack of salutogenic ecosystem services i.e., people more exposed to unhealthy environments and the capacity to cope with stress through exposure to nature is greatly reduced.

Urban areas in low- and middle-income countries are simultaneously home to the healthiest and the unhealthiest populations.

## KEY RESEARCH PRIORITIES

Understanding the complexity of institutions, actors and processes related to urban health.

The influencing mechanisms between EC and health outcomes, both negative and positive, focusing on how to make cities healthier places, not only what affects health negatively (salutogenetic perspective).

What is the effect of global change on health?

Understanding the multiplicity of health systems and the interactions between the public and private and different health care systems, user behaviors and what it means for health monitoring, e.g., Ayurvedic vs. some other forms.

How can we generate data under the conditions in agglomerations of the South (informality, lack of reporting, etc.)? How can we analyze and disseminate information about health problems to decisionmakers in a more timely fashion? How can we respond to outbreaks? How can health monitoring better inform city planning?

Research must develop smart strategies to identify social and spatial differences (and perceptions) of health risks.

Develop innovative ways of disseminating and of building awareness of urban health issues.

## POLICY RECOMMENDATIONS

We need better governance of rapid urbanization to build more inclusive and healthier cities.

We need to look at urban form and how we can build healthy urban spaces (understood to some extent, but not completely); this affects urban planning at all scales: the buildings, healthy neighborhoods (inclusion of urban green and urban blue as salutogenetic elements of cities) and a master plan in which health issues are a crosscutting issue).

Empowerment of the people affected, and empowerment of women is important in this context.

There is a great need for more participatory planning processes and to increase health care knowledge throughout the population – not only for planners, but also local people.

Targeted health services for the vulnerable and provision of accessible preventive and curative services are needed.

Increase resources for the local health care sector, i.e., people who are most aware of local health situations should have the most resources (subsidiarity vs. top down planning; requires also financial empowerment of local administrations).

Reorganization of the health care sector, with more transparency and increased quality of services.

Knowledge-based and demand-oriented services (non-communicable diseases on the rise as well as communicable diseases).

Influences of extreme events on health; this is related to disaster preparedness and planning.

## ORGANIZERS

Carsten Butsch, University of Cologne, Cologne, Germany

Frauke Kraas, University of Cologne, Cologne, Germany

## PRESENTATIONS

Humphrey Ngala Ndi, University of Yaounde I, Yaounde, Cameroon

*Environmental change and the relapse of malaria in Maroua, far north of Cameroon*

## SUMMARY

Malaria is the greatest health challenge in sub-Saharan Africa. Innovations in controlling the disease are a permanent occurrence in both private and public sector agencies. Examples include the Roll-Back-Malaria Initiative, the free distribution of treated mosquito nets and free treatment of severe malaria in infants. Researchers and policymakers believe that global warming will aggravate the prevalence of infectious diseases, including malaria. Some evidence now indicates that the malaria belt will gradually expand into southern Europe due to rising temperatures and rainfall. The far north region of Cameroon (mostly Sahel), has experienced severe flooding in the past few years, resulting in an increase in instances of malaria. In August 2013, over 10,000 malaria cases were registered in Maroua and close to one thousand patients died. Notwithstanding the role of global warming on rainfall and temperatures and other factors in the ecology of malaria, this study posited that though environmental change provides the enabling environment for the malaria vector, economic and social factors aggravate epidemic characteristics in the region and city.

## KEY LESSONS LEARNED

Malaria transmission in Maroua is strongly seasonal in rhythm.

Along with climate change, health system performance, poverty, culture, and local traditions are factors in the increase of malaria in the city of Maroua.



The increasing frequency of floods aggravates the rates of malaria transmission. However, not all episodes are caused by the intensities of rain storms alone; issues of infrastructure, including the collapse of dykes and dams on the Logone River, have also contributed to the increase.

Although the ownership of treated mosquito nets is over 85%, few people use them.

House windows, usually open during hot nights to increase ventilation, are generally not fitted with mosquito nets.

The death rate from malaria is aggravated by poverty. The region ranks poorest in the country with a poverty rate of 56.3%, above the national average of 38.7%.

### **POLICY/PRACTICE IMPLICATIONS OF RESEARCH**

Understanding how global climate changes affect changing malaria prevalence is important in the context of urban planning and proper health care policy and infrastructure.

The built environment as it is reflected in urban management policies can help prevent or reduce malaria transmission.

### **KNOWLEDGE GAPS AND NEEDS**

The increasing flood rate in the far north region of Cameroon merits further investigation into the possible relationships between floods and the increase in Malaria. It may have implications on other meteorological events occurring elsewhere on the globe, such as El Niño and La Niña events.

Architectural designs to integrate malaria risk are needed and must be enforced by Local Councils.

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**Joshua Sperling**, Patricia Romero-Lankao, & Daniel Runfola, National Center For Atmospheric Research, Boulder, CO, USA

*Exploring health outcomes, inconveniences, and perceived risks associated with infrastructure, pollution and extreme weather events in Mumbai, India*

### **SUMMARY**

This presentation shared findings on health outcomes, inconveniences and perceived risks that may be associated with infrastructure provisions, air pollution, or climate-related extreme weather events by residents in different neighborhoods of Mumbai, India. National survey data and analyses of over 1,200 household surveys conducted with international partners were utilized to help explore how households of varying socio-economic conditions within different areas experience different illnesses and inconveniences. Household perceptions of risk across these areas were also compared as part of analyses on local policy priorities regarding most important changes to improving health and well-being. The results presented demonstrate high levels of household interest in improved infrastructure conditions over pollution or extreme weather events, yet less than 50% of residents view local action on health risks related to pollution and extreme weather events as also important. Finally, geospatial analyses of household surveys helped visualize the opportunities for integrating activities within socio-institutional and built environment systems for improving health, infrastructure provisions and reducing environment- and climate-related risks across different Mumbai neighborhoods.

### **KEY LESSONS LEARNED**

Less than 50% of surveyed households (n=1258) view city action on climate change, pollution and extreme weather as important, yet those lacking basic infrastructure provisions will prioritize that first over other perceived environmental risks.

### **POLICY/PRACTICE IMPLICATIONS OF RESEARCH**

The differences in local conditions within a city are significant and often interconnected with risk perceptions, priorities for development and capacities to manage risks. The results demonstrate how city goals may range from reducing pollution and managing extreme weather to providing access to high quality infrastructures and services, yet with more emphasis needed on participatory

and evidence-based processes for how cities can prioritize actions within and across the city and its' diverse neighborhoods.

### KNOWLEDGE GAPS AND NEEDS

Additional research in cities that integrates health outcomes data with household experiences in response to hazards and perceived risks of future hazards by location can help inform how households with varying local conditions within city neighborhoods experience different health risks, inconveniences, and capacities to manage risks related to infrastructure, pollution and extreme weather events.

Future research methods that increasingly utilize simple SMS cellphone technology to provide real-time data that integrates with geospatial analyses of household surveys can help visualize key opportunities for integrating activities within socio-institutional and built environment systems for improving health, infrastructure, and reducing environment- and climate-related risks within and across cities.

A better understanding of disease burdens related to socio-economics, including data on access to healthcare and mortality data that includes causes of death, given that many deaths are not reported in developing country cities.

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**Mareike Kroll**, Revati Phalkey & Erach Bharucha,  
University of Cologne, Cologne, Germany

Sayani Dutta, Bharati Vidyapeeth University, Pune, India

*Challenges for monitoring non-communicable diseases in Pune, India*

### SUMMARY

The rising burden of non-communicable diseases (NCDs) constitutes one of the major global public health challenges in the 21st century. In India, NCDs contribute to an estimated 53% of all deaths, mainly attributable to cardiovascular disease, chronic respiratory disease, cancer and diabetes. NCDs are largely preventable, given their link to common

risk factors such as tobacco and alcohol abuse, unhealthy diet and lack of physical activity amongst others. Due to the quality adjusted life years lost and the long-term treatment costs involved in chronic care, they pose a threat to economic and social development, especially in emerging economies in the Global South. Urban agglomerations pose special challenges to health given their socio-economic and environmental dynamism. Improvement of urban health therefore requires tailor-made efforts strongly focusing on health promotion, disease prevention and chronic disease management. Effective interventions require reliable evidence and routine surveillance data. Taking this as a point of departure, the objective of this collaborative research project between the University of Cologne, Germany and Bharati Vidyapeeth University, Pune, India, was to develop and test a model sentinel surveillance system for selected NCDs in three pre-identified research sites in Pune. The system aimed to involve private health care facilities, particularly at the primary health care sentinel sites, given that they are the first point of care for over 80% of ambulatory consultations.

### KEY LESSONS LEARNED

Improvement of urban health requires tailor-made efforts strongly focusing on health promotion, disease prevention and chronic disease management. Effective interventions require reliable evidence and routine surveillance data. Disease surveillance, defined as the ongoing systematic collection, analysis and interpretation of health data (disease burden, health risk factors, access to health care), is an important foundation for planning, executing and evaluating public health interventions.

Despite the increasing prevalence of NCDs, the majority of the current surveillance efforts in India focuses on communicable diseases. The private sector is not adequately included in surveillance programs despite its dominant role in urban health care. Reliable data on the disease burden of NCDs and their risk factors do not exist in Pune.

Preliminary results from the pilot study show that involvement of private practitioners in NCD

surveillance is feasible and important given that they are the main entry point into the health care system and play an important role in initial screening, diagnostic and treatment of NCDs.

Major barriers include a lack of knowledge regarding surveillance, the limited infrastructure in these clinics with lack of manpower, limited record keeping and low availability of electronic medical records, legal aspects (e.g., alternate practitioners are not supposed to provide allopathic treatment) and poor relationship between the private and the government sector. Clear reporting structures and training of participating practitioners are therefore important prerequisites for regular surveillance.

### **POLICY/PRACTICE IMPLICATIONS OF RESEARCH**

Reporting of the selected diseases must either become mandatory, or incentives must be provided for voluntary reporting, e.g., of selected sentinel sites. Since the private health care sector is largely unregulated, the integration of private practitioners must be ensured. A specific problem arises from the fact that Ayurveda and homeopathy practitioners are an important source for primary care in Pune, though they are legally not allowed to provide allopathic treatment. Legal barriers discourage these practitioners from reporting tuberculosis or diabetes cases.

A standardized format for data collection, as well as a procedure for data analysis and regular, timely dissemination of results, needs to be developed and implemented. The limited availability of electronic devices and electronic medical records at the primary care level remains a challenge. Therefore, a responsible authority must be identified and equipped with the necessary infrastructure.

### **KNOWLEDGE GAPS AND NEEDS**

Combating the rising burden of NCDs requires multi-sectoral action on various levels.

NCD surveillance is an important part of the process to derive evidence-based health policies and programs.

In low- and middle-income countries, the lack of comprehensive and standardized electronic medical records (especially on the primary care level), lack of other data sources such as health insurance data and absence of unique patient identifiers to link different data bases hinder the implementation of NCD surveillance systems.

Overcoming the challenge of integrating the often unregulated private sector in surveillance activities.

Increasing the availability of socioeconomic and spatial data, in order to identify social and spatial health disparities within a population is of high priority in low- and middle-income countries, which are often characterized by widening health disparities.

More interdisciplinary research is required on these issues to develop adequate NCD surveillance structures in the Global South.

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Tabea Bork-Hueffer, National University of Singapore, Singapore

*Governance challenges in China's urban health care system: Effects for the domestic and international migrant population*

### **SUMMARY**

This presentation contributed a deeper understanding of challenges in China's health system governance by contrasting levels of influence and the roles of different stakeholders in the health system including government bodies, public, private and illegal health care providers, patients (here with a focus on domestic and international migrants) and their social networks, paying institutions, medical goods and equipment producers, social organizations and civil society. It shed light on the effects of health governance on domestic and international migrants' access to health care. Misdirected and uncoordinated reforms of the health care system, persistent informal modes of power negotiation, lack of regulation and control, co-eval post-reform diversification of types of health care providers and an increasingly self-assertive as well as economically-oriented group of providers have

led to an increasing imbalance in stakeholder power within the governance network. Countervailing these imbalances is a prerequisite to achieving the central goals of a health system - improved health, enhanced responsiveness and increased fairness in financial contribution.

### KEY LESSONS LEARNED

Governance only works if all stakeholders across the health system are involved.

Imbalances in the roles and influences of stakeholders currently aggravate the improvement of migrants' access to health care.

Administrative units are responsible for regulation and control at the same time, but they are often understaffed and corrupt.

Health care providers have increasingly more influence on aspects of health care regulation.

There is a lack of third party independent supervision to intervene in this stakeholder relationship, e.g., insurance companies often take this role in health care systems within social insurance systems.

Migrants often rely on social networks for medical help or assistance with medical bills.

### POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Health-related return migration needs further study.

Reforms have been made to improve health care, but some neglected elements include: the lack of third party supervision and monitoring; extension of regulation to the private sector; overall reforms of administrative structure including the integration of government ministries and other units; corruption; institutionalization of relationships between the administrative units; the responsiveness of health care providers; government funding to achieve these goals; patient organizations and the work of social organizations should be strengthened (in particular for migrants); and, increasing of awareness and options for migrants and establishing targeted health

services for migrants which can be easily achieved through already existing structures.

### KNOWLEDGE GAPS AND NEEDS

How well were the health care reforms implemented?

What is the role of mobile unregistered health practitioners?

How do other international migrant groups accept the social insurance system?

More research on highly skilled international/domestic migrants, in addition to low- and middle-skilled migrants.

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Surinder Aggarwal, University of Delhi, Delhi, India

*Acting on social determinants of health to promote healthy urban settings*

### SUMMARY

Urban areas in developing countries are developing quickly and in a haphazard manner, with little care for resulting environmental and social damages. Accompanied with these impacts are critical changes in lifestyles, social fragmentation and the growing burden of urban poverty. As a consequence, urban residents suffer from the burden of communicable and non-communicable diseases. Health outcomes of such changes are clearly reflected through changing health transitions and rising health inequities. The challenge lies in taking the appropriate actions to promote healthy urban settings. In this study, the Social Determinants of Health (SDH) approach, promoted by the WHO in 2008, was applied to address such health issues as well as the urban HEART method to tackle health inequities in the urban settings of selected Southeast Asian cities and India, in particular. The case study of Ahmedabad, India, demonstrates how empowerment of poor, self-employed women translates into better health outcomes through environmental improvement, better housing and low-cost health care.

## KEY LESSONS LEARNED

Action on social determinants of health (SDH) is an approach for achieving health equity within and among countries.

The study on Self Employed Womens Association of India (SEWA) in Ahmadabad was considered a good example of how empowerment (as a major social determinant) of more than one million slum women in India and abroad brought structural changes in their living and working environments, income generation, child enrollment in schools and health situations through this approach.

Understanding the structural pathways of empowerment such as distribution of power, income, goods and services, circumstances of people's lives (access to health care, schools and education, conditions of work and leisure, state of housing and physical environmental changes) and their links with health outcomes is crucial for producing and creating good health. Social justice is a matter of life and death for the vulnerable communities living in informal settlements. These emerge as the best determinants of health from the SEWA study while capacity building, partnership, networking and self-reliance remain the primary instruments of change.

Providing financial security, basic health insurance, intersectorality, community participation, social networking, institutional building like forming cooperatives (housing, health, environmental), building alliances with different stakeholders and self-reliance can deliver low-cost health solutions.

Committed and well-managed institutions like SEWA can mitigate environmental change-linked health impacts on marginalized communities living in hazardous settings. Their approach and actions of 'empowerment and capacity building' can be aptly applied towards improved health outcomes under GEC scenarios.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Establish national institutional mechanisms to coordinate and manage inter-sectoral action for health, in order to mainstream health equity in all policies, and, where appropriate, by using health and health equity impact assessment tools.

Improve the technical capacity of municipalities and corporations to plan, implement, measure and evaluate health inequities and social determinants of health.

Develop, strengthen and reinforce information systems in various sectors and routinely generate data and produce evidence on health inequities (disaggregated by age, gender, ethnicity, etc.) and their determinants to keep the focus on, and monitor progress of, the implementation of policies and programs.

Report and share with different constituencies the evidence of health inequities on a regular basis, in order to advocate and sustain inter-sectoral actions.

Develop and promote a network of individuals and institutions to facilitate collaborative research, and the distribution of information, experiences and best practices.

Be aware of widening health inequities as a result of globalization and urbanization, and advocate for good governance and corporate social responsibilities at the local and global level.

Health development models and the Health Improvement Index, as developed in this study and based on the SEWA experience, can be adapted for other communities in different settings.

Social determinants of health need to be addressed through strong local governance.

## KNOWLEDGE GAPS AND NEEDS

Emphasis is needed on issues of linking health with degraded and/or shrinking urban ecosystems.

How to promote and regulate Asianurbanization, especially in China, to make it environmentally sound and socially inclusive?

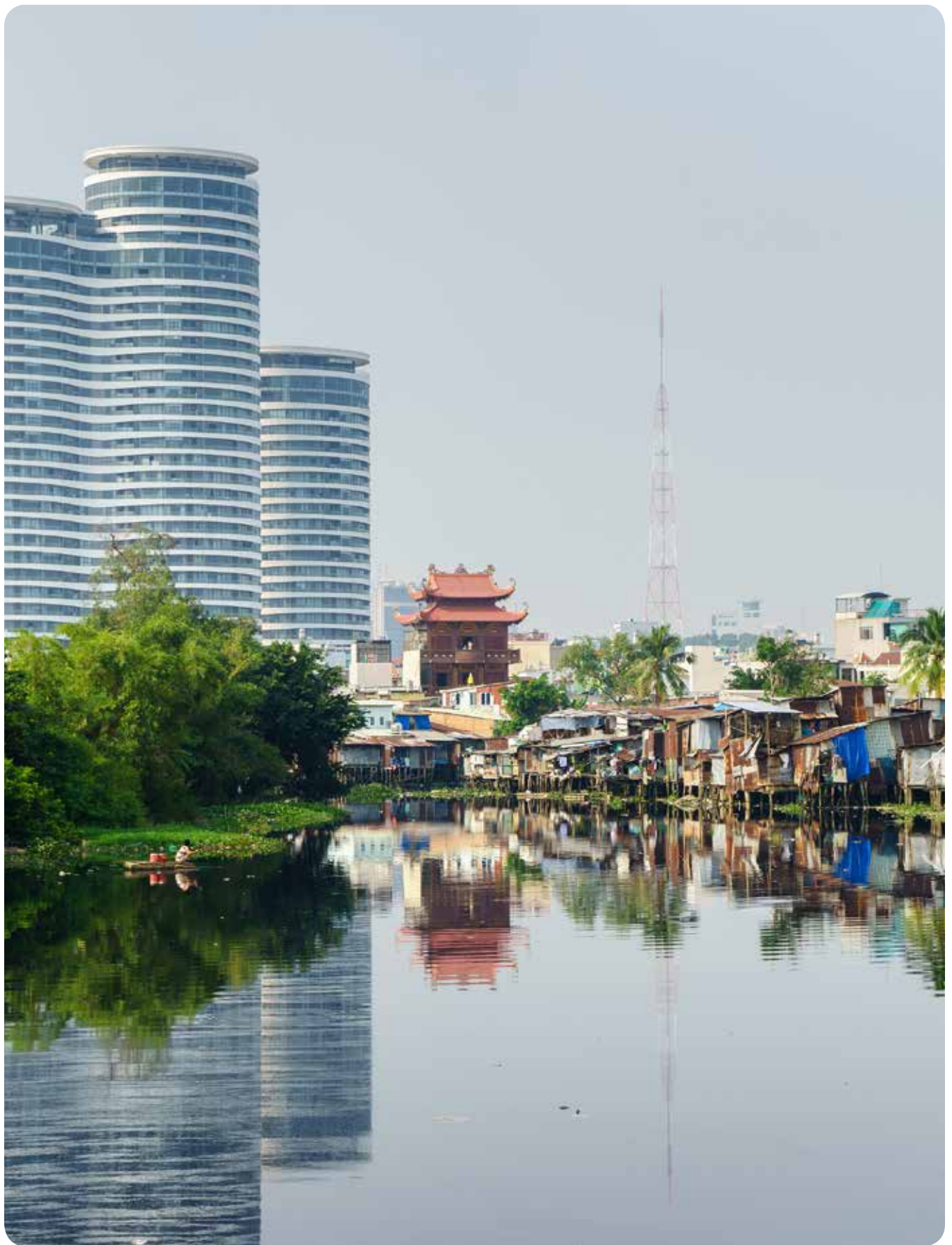
To understand the specific impacts of the activities of institutions like SEWA, a more comprehensive and scientific study with a large database and more spatial coverage needs to be undertaken.

Is a holistic approach that links economic benefits with social gains like health more acceptable to poor families rather than a program that focuses on a single issue?

Promote the SDH approach and actions through evidence gathering, dissemination, monitoring and advocacy, and integration of health equity in all policies.

Engage researchers and research institutions to identify and measure health inequities using a Social Determinants Health approach in order to provide the critical evidence required by policymakers and funding agencies to take action.

Social determinants of health need to be addressed through strong local governance.



# Theme 4 Equity and Environmental Justice in Urban Areas

Sustainability is founded on principles of equity for present and future generations. Worldwide, more than 900 million people, approximately one out of three urban dwellers, live in informal settlements, with most living under life- and health-threatening conditions. This ratio is expected to increase in the future. In light of their importance locally and regionally, and considering their size globally, the discussion of sustainability must incorporate approaches that include informal settlements. Furthermore, just as the concept of climate justice addresses the uneven negative impacts of global climate change especially on poor countries that, for example, contribute only a small portion to global greenhouse gas emissions, an environmental justice perspective that examines the fairness of services and disservices provided by the environment brings us closer to the goal of urban sustainability.

Similar to the focus areas of urban health and well-being in Theme 3, Theme 4 remains an understudied area of research for the UGEC community and does not yet have the breadth of coverage that is provided by Themes 1 and 2. Theme 4, thus, will be an important avenue for research into the next phase of urban and environmental change research, where insights from political science and theory as well as the humanities can offer substantial contributions. The conference sessions under this theme, however, provided a good contribution to what we've come to understand, and also what we need to focus on for the future with respect to the interactions between global environmental change and human security, vulnerability and coping mechanisms of the global poor. Questions that were more specifically addressed and remain salient for future research include: How can we best influence growth and development policies for urban areas in both rich and poor countries alike, and assist them to better adapt to the potential negative consequences of global environmental change? What advances can be made in terms of woman and gender equality with respect to climate change mitigation and adaptation policies? This theme also acknowledged the critical need to address the developing urban world, its specific challenges, needs and opportunities for more livable cities.





# Session 44 Footprinting and low carbon urban infrastructure development

## SESSION ABSTRACT

The concept of 'green growth' has been connected to the 'green economy for sustainable development and poverty reduction', which is the first theme of the Rio+20 United Nations Conference on Sustainable Development (UNCSD). Rapid growth requires intensive urban infrastructure development, but due to the constraints of local government capabilities, the funding of urban infrastructure has become a critical issue. Against this background, this session explored and examined a new funding mechanism with the engagement of many stakeholders including public-private partnerships. Several cities already have invested in initiatives for green cities.

This session highlighted a two-year project, used as guidance on how cities in selected countries can play a key role in the green growth agenda by stimulating growth through smart investment in urban infrastructure, i.e., by building a physical infrastructure, by financial and tax incentives, energy supply and heightening society's awareness of a sustainable lifestyle. This two-year project funded by APN ranges from institutional analysis, life cycle assessment and risk analysis to integrated assessment with the study cases of Jakarta, Shanghai and Yokohama.

Furthermore, this session addressed the quantification of urban carbon footprints and their contribution to global, regional and national GHGs. Given the slow progress of international climate policy negotiations, cities and their citizens are playing a pivotal role in the mitigation of climate change. However, approaches to carbon footprinting are facing some methodological and empirical problems: Data availability for both footprinting methods; questions of boundaries (legal boundaries in the case of cities, individual/household boundaries in the case of personal carbon

footprints); 'grey' energy in cities, including urban infrastructure related emissions; and, problems of communication and dissemination beyond the level of technical experts. Can public communication of carbon footprints help to put forward the idea of environmental justice, and vice versa, can urban mitigation policies help to reduce social inequalities, thus contributing to an improved social 'climate' of cities?

*Keywords: green growth, infrastructure, city, investment, climate change, urban carbon footprints, individual carbon footprints, climate change mitigation, lifestyle, consumption, climate policy*

## ORGANIZERS

Joni Jupesta, United Nations University, Yokohama, Japan

## PRESENTATIONS

**Ping Jiang**, Yihui Chen & Wenbo Dong, Fudan University, Shanghai, China

*Economic policies to incentivize the development of green buildings in China*

## SUMMARY

Low carbon sustainability is one of the major topics focused on in the study of urbanization, and especially the use of green buildings to push urban areas towards becoming low carbon. In China, green buildings are viewed as important steps towards a more low carbon society. This presentation focused on the economic aspects of green buildings, including a discussion of a method to explain the incremental cost of green buildings and to compare those costs and subsidies of the government.

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**Takako Wakiyama** & Ambiyah Abdullah, Iges,  
Hayama, Japan

Joni Jupesta, United Nations University - Institute Of  
Advanced Studies, Tokyo, Japan

*Investment risk and return analysis for low carbon city  
development in Yokohama*

### SUMMARY

This presentation analyzed risks of and returns on investment of renewable energy in the case study of Yokohama. In order to avoid risks, the role of government, policy target setting, the provision of financial support, and introduction of new and innovative policies are necessary. Thus, in the case study, policy status and supports as well as innovative financing were examined qualitatively and quantitatively. Discount cash flow analysis using Monte Carlo simulation was applied to analyze the risks and returns from renewable energy businesses. As a financing method, this research explored the effectiveness of feed-in-tariff (FIT) and supplemented tax policy. For further details to assess the impacts of low carbon investment of renewable energy in Yokohama, the economic, environmental and social contexts in the city were assessed using an input and output model. The study addressed how low carbon investment on renewable energy can enhance the economic (GDP, electricity supply) and environmental benefits (CO<sub>2</sub> emissions reduction) in the city.

### KEY LESSONS LEARNED

There is a strong economic impact from investment in renewables such as solar and wind.

Thermal power generation is used for many production sectors, thus, political intervention is required to increase renewables to help achieve climate change mitigation targets.

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**Tzu-Ping Lin** & Feng-Yi Lin, National Cheng Kung  
University, Tainan, Taiwan

Yu-Cheng Chen, National Chung Hsing University,  
Taichung, Taiwan

*Energy use and carbon footprint mapping of buildings in  
urban areas*

### SUMMARY

Focused on Kaohsiung and Taichung metropolitan areas in Taiwan, this study explored the building energy consumption by building types, land use, urban land use code and human behavior. First, various types of building densities were collected from previous studies and put into a database. Thereafter, the Energy Plus model was applied to simulate hourly energy consumption in residential and commercial areas according to their usage and location. This energy use intensity was divided into six time periods and four seasons, and the energy consumption was calculated and presented in a 200×200m grid in two urban areas where sensitivity analysis was applied to indicate hot spots of energy use. The results indicate that the energy consumption hotspots appear at noon during summertime in the urban-intensive business district.

### KEY LESSONS LEARNED

Global climate changes may contribute to the increase of energy use if the response is to maintain comfortable indoor environments through the air-conditioning. Mapping our understanding of urban energy consumption and hot spots of energy use can display ways to make specific area improvements.

This study defined residential and commercial area energy use intensity, which can be used as future predictive scenarios of urban energy consumption and assist urban planning.

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**Tsung-Chen Lee**, Chia-Tsung Yeh, & Chen-Yu Chan,  
National Taipei University, Taipei, Taiwan

Shin-Kun Peng, Academia Sinica, Taipei, Taiwan

*Bottom-up urban CO<sub>2</sub> emissions: A consistency check  
with top-down national estimates*

## SUMMARY

Although climate change has been recognized as a global externality, climate responses are, in fact, multi-spatial. In this regard, the roles and responsibilities of cities in CO<sub>2</sub> mitigation have drawn increasing attention in the recent years. To facilitate the optimal design of effective mitigation policies at city levels, it is essential for city authorities to understand the magnitudes and sources of their CO<sub>2</sub> emissions. At present, however, the widely accepted principles of estimating CO<sub>2</sub> emissions, such as IPCC guidelines are, in general, at the national level. Despite several academic papers, international or national protocols, and local government guidelines suggesting the methods of estimating CO<sub>2</sub> emissions at the city level, few justify the robustness of their estimates. In addition, there is a lack of cross-cities comparison and consistency check with national top-down estimates. To bridge this gap, this research has constructed a comprehensive 'bottom-up' framework for estimating urban CO<sub>2</sub> emissions, offering a consistency check with 'top-down' national estimates.

## POLICY/PRACTICE IMPLICATION OF RESEARCH

The geographic distribution of CO<sub>2</sub> emissions are displayed in the case study of Taiwan. This 'CO<sub>2</sub> emissions map' provides important information on the coordination of climate policies at top-down national levels and bottom-up urban or regional levels.

Market-based measures (MBMs) of carbon mitigation (i.e., carbon taxes and emissions trading schemes) serve as cost-effective policy instruments, which are of considerable attention, but most of the associated economic impact analyses to date are performed at national, multi-country or global levels. These studies may belie the extreme economic impacts on individual cities or regions because they provide only the averages at higher spatial levels. The 'CO<sub>2</sub> emissions map' could serve as a supplement for better understanding the impacts of MBMs at lower spatial levels. With this information, any urban- or regionally-coordinated set of measures to alleviate

the burden of MBMs could be more effectively targeted if the most adversely affected sectors within the city or region are identified.

## KNOWLEDGE GAPS AND NEEDS

In order to implement carbon mitigation policies effectively, the following are needed:

A thorough analysis of the sources and drivers of GHG emissions at different spatial and temporal scales;

A full understanding about the mitigation potentials, consisting of mitigation sectors and their actions; and,

A city- or regional-wide impact analysis of MBMs.

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**Retno Gumilang Dewi**, Ucok Siagian & Iwan Hendrawan, Institut Teknologi Bandung, Bandung, Indonesia

Rizaldi Boer & Lukytawati Anggraeni, Bogor Agricultural University, Bogor, Indonesia

*Low carbon city infrastructure development paths of Jakarta towards 2030*

## SUMMARY

The development paths of the transportation sector in Jakarta are informed by energy supply plan scenarios and are to be in line with the 'green growth' concept and 'green economy' for sustainable development and poverty reduction. The main objective of the modeling study was to identify the infrastructure development paths and to show how Jakarta can play a key role in the green growth agenda by stimulating the growth through smart investment in urban infrastructure that is related to energy supply plans in the transportation sector. Mitigation under low carbon development paths is focused in transportation, i.e., switching to less GHG emitting fuels, efficiency measures and changes of transportation mode.



# Session 56 Towards livelihood security and social justice: The urbanization, infrastructure and governance nexus

## SESSION ABSTRACT

There is an increasing body of work that illustrates that uneven access to water is attributable to factors such as race, class and gender, but shaped by conventional governance regimes that build on large-scale infrastructures and market approaches to water tariffs (Bakker et al., 2006). Understanding and explaining the factors that influence the spatial and social differentiation of access to water and debating how to design better water governance models in an increasingly urban world under conditions of global change were the two primary goals of this session.

These issues essentially reinforce the recurrent social and development challenges in the context of climate change confronting much of the world today. The 'nexus' approach highlights the interdependence of governance and livelihood security with the natural system that underpins security - in this context, water security. The 'nexus' debate is primarily about governance, natural resource scarcity (e.g., uneven distribution) and uneven allocation and access to water by the least powerful in society. This session explored the 'nexus' between rapid urbanization, socio-technical systems (infrastructure) and governance regimes and looked at the connection between these factors and explored how they shape unevenness and injustice in access to water all over the globe.

*Keywords: urbanization, infrastructure, livelihood, water, governance*

## KEY DISCUSSION POINTS

There are many difficulties in enabling behavior change in household practices, e.g., who turns on the heater; or financial competencies. This reflects the complexity of social adaptive capacity in households and organizations that provide services to communities.

The conceptualization of cities needs to move beyond urban borders to include peri-urban and rural areas. Urban areas need to give compensation to areas from which resources, especially water resources, are retrieved. Cities also must improve their use of water resources from these areas.

Disaster risk reduction can be strengthened through the examination of local land use plans, which can also help improve climate change adaptation efforts.

Climate change communication should be framed by different organizations for different users. The key points of climate change must be communicated in such a way that speaks to the livelihoods of individuals and communities.

## ORGANIZERS

Federick Ato Armah, University of Cape Coast, Cape Coast, Ghana

Antje Bruns, Humboldt University, Berlin, Germany

Hartmut Fuenfgeld, RMIT University, Melbourne Australia

Mark Pelling, King's College London, London, UK

## PRESENTATIONS

**Obed Kawanga** & Tsoka Phiri, Network For Environmental Concerns & Solutions (Necos), Lusaka, Zambia

*Urban adaptation to climate change: A Case of Madimba Settlement, Lusaka, Zambia*

## SUMMARY

There are many vulnerabilities and anticipated impacts of climate change on various water and sanitation technologies in the peri-urban area of

Madimba in Lusaka, Zambia. This study was based on a methodology of longitudinal action-oriented adaptive field work for a period of six years (2008 to 2013), which brought out three distinctive climate adaptive sustainable improvement strategies: ecosystem, economic and socio-cultural.

Embarking on climate change adaptation and resilience, it is necessary for any city to develop appropriate urban adaptation options that work with the given ecosystem. Perspectives on the requirements for peri-urban settlements were shared by stakeholders such as the Lusaka City Council, the Lusaka Water and Sewerage Company, water trusts, and non-governmental organizations (NGOs).

### KEY LESSONS LEARNED

The residents of Madimba and other similar peri-urban settlements not legally recognized by their governments face challenges in implementing climate change adaptation initiatives, such as tree planting, construction of drainages, access to safe water and the introduction of the early maturing crops, etc.

### POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Climate change adaptation initiatives need to be spearheaded by experienced and knowledgeable individuals with input from local residents. When creating policies concerned with climate change, the government should incorporate the knowledge appropriate to local conditions. This may help in the formation and implementation of long-lasting working policies.

Climate change should be a crosscutting issue in all development programs. Increasing awareness of new farming techniques can also improve adaptation initiatives as well as enhance food security.

The government should increase funding to authorities, such as environmental health experts, in order to widen the coverage of climate change initiatives and their implementation.

Abolish the construction of septic tanks (except polythene-lined) and soak-ways in areas with high water tables or that are prone to flooding.

Every school and educational institution should have a minimum of ten trees. This policy will help increase the nation's carbon sink base.

### KNOWLEDGE GAPS AND NEEDS

The absence of the local authority in Madimba is a missing link between the grassroots level and the central government.

The impacts of climate change adaptation initiatives need to be monitored, in order to determine their effectiveness.

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Jonathan Barton, Pontificia Universidad Catolica de Chile, Santiago, Chile

*No picks, no shovels, no helmets: Local governments at the coalface of adaptation to water stress in Chile*

### SUMMARY

Faced with lack of inertia and fragmentation, the task of climate change adaptation has increasingly been left to local governments, arguably the weakest level of government due to the centralized nature of the Chilean state. This presentation shared two experiences of climate change adaptation at the Chilean municipal level and revealed major obstacles faced by local governments. The first - legal responsibilities - relates to the role of municipalities in the provision of emergency fresh water to local populations, particularly in municipalities on the fringes of the largest cities, which are subject to urbanization pressures and changing land uses. The second - information scarcity - involves water use for green spaces. While higher-level public institutions discuss strategic and future concerns relating to climate change, it is at the local level that adaptation is taking place. However, this adaptation is not matched with adequate information and financing, and the de facto responsibilities assumed by these authorities are neither recognized nor formalized. Effective urban

adaptation in Chile requires decentralization, in order to address this imbalance.

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**Susie Moloney & Hartmut Fuenfgeld**, RMIT  
University, Melbourne, Australia

*Adaptive capacity and climate justice: Reflections on two projects in Victoria, Australia*

## SUMMARY

The impacts and capacity to respond to climate change are unevenly distributed spatially and socially. While debates about climate justice have mainly occurred at the international scale, there is a call to better understand how climate justice is pursued at the urban scale and to incorporate issues of recognition as well as rights and responsibilities as facets of just responses to climate change (Bulkeley et al., 2014). Recognition of varying capacities to respond to climate change is important, as this can help reshape understandings of responsibilities and how issues of poverty, exclusion or socio-cultural factors are implicated. The notion of climate justice reflected through two climate change projects both located in Victoria, Australia was examined in this presentation.

The first project focused on the capacity of the community services and primary health care sector to respond and adapt to the impacts of climate change. Where climate change impacts affect socio-economically disadvantaged people and the services they rely on, extreme hardship and the severe consequences for individuals and communities that follow, amount to localized manifestations of climate injustice. The second project focused on a state government-funded initiative delivered through a social services organization, which engaged with 144 low-income households suffering from financial hardship. This initiative aimed to assist householders in taking responsibility for reducing their energy use through behavior change and minor retrofits. The project highlighted the vulnerability of low-income tenants in poor quality housing and the limited capacity to adequately adapt and respond to climate

impacts. Both projects serve to illustrate the different ways in which issues of climate justice manifest in the urban context and how the adaptive capacity of service providers and those most vulnerable can be improved.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

There are observable inequities regarding distribution of responsibility for dealing with the effects of environmental change, particularly as we are seeing a growing number of local, place-based non-governmental organizations and community groups attempting to generate change in the absence of leadership from higher levels of government in Australia; and there are weaknesses and gaps around capacities to act and enable change and the requirement for multi-level governance.

These current challenges present opportunities for including climate justice considerations in key policies and practice. Using that understanding to develop more informed and effective solutions for change that recognize that multiple and coordinated strategies are needed to enable and support systemic environmental change.

## KNOWLEDGE GAPS AND NEEDS

Climate justice considerations do not feature prominently in policies and practice supporting socially vulnerable segments of the population in the study area. Current knowledge of the linkages between climate change impacts and their social justice implications is limited, in particular with regard to the following:

What are the effects of service cost increases, service disruptions, delays and drops in service quality as a result of climate change impacts?

What are appropriate degrees of shared responsibility between individuals, service providers and government regulators to avoid poor justice outcomes in the face of climate change?

What climate (in-)justice outcomes can we expect to see as a result of particular climate related-events and trends?



What climate (in-)justice outcomes can we expect to see as a result of climate change policies and regulation?

How can service providers be supported in developing their capacity to plan for more just outcomes?

There is further need for development of theoretically informed research with shared language and analytical models. There are opportunities for undertaking comparative studies, in order to learn from different contexts to assist in better understanding the role and capacities of actors and agencies involved in implementing and delivering programs for environmental change. This comparative research can also contribute to our understanding of the factors influencing urban vulnerability and capacities to adapt to and mitigate climate change.

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Patricia Avila-Garcia, National Autonomous University of Mexico, Mexico D.F., Mexico

*Global change and social conflicts over water in Mexican cities*

## SUMMARY

Global change involves worldwide biophysical (climatic change), social (urbanization and poverty), and economic (globalization) processes having a differential effect on regions and territories. In the case of Mexico, these processes contribute to the exacerbation of water-related problems, as expressed by the loss of water security and the escalation of social conflicts, particularly in urban areas and their hinterlands. The water crisis in cities leads to:

An increased social vulnerability to changes in climatic patterns and extreme events that affects the poorest populations because it affects high risk areas (marginal lands);

A deficit of basic water needs, such as drinking water and sanitation, that is further augmented by high poverty levels and social inequality, and by water stress in urban areas (the major part of Mexican cities have low water availability);

A deterioration of ecosystems and water resources (scarcity and pollution) due to the adoption of non-sustainable practices (deforestation, industrial wastes without treatment, water use and pollution by mining), the construction of megaprojects (large dams, water transfers between river basins), and urbanization (land use change); and,

An institutional and legal framework inability to address the rapid urbanization and manage water conflicts between states and society; this is due to dominant economic power and interests (social and environmental injustice).

This presentation examined the question of how global change affects water security leading to social conflict scenarios in urban areas of México. With the purpose of explaining the escalation of social conflicts, the results of a theoretical consideration of the relation between global change and the water crisis in urban areas was presented, along with a comparative analyses of cases of water conflict occurring in Mexican cities and their links with global change.

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Riyanti Djalante, Local Government of Kendari City & University of Halu Oleo, Kendari, Indonesia

*Linking disaster risk reduction and climate change adaptation at the local level: Experience in implementing a resilience city program in Kendari, Indonesia*

## SUMMARY

Linking Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) is important as climate change is likely to increase the frequency and severity of hydro-meteorological hazards. The simultaneous application of DRR and CCA also results in more efficient use of financial, human and natural resources and therefore increases the effectiveness and sustainability of both approaches. The climate change research community is in danger of 'wasting time and money in reinventing the wheel' by conducting these activities separately.

This presentation gave an overview of how the integration of DRR and CCA takes place in practice. It outlined the presenter's experience in implementing a 'Resilient Village' program and how the community perceived their vulnerability to climate-related hazards. Related activities included a five day workshop with 30 participants in two locations (Lepo-Lepo and Kampung Salo) in Kendari City, Indonesia.

### **KEY LESSONS LEARNED**

There can be institutional compartmentalization between those who deal with the effects of disasters and those who manage the recovery.

Moving from plan to implementation can be difficult and problematic, especially when there is a lack of funding.

There is a lack of collaboration between the private and public sector, and no alignment of planning with normal development cycles.

### **KNOWLEDGE GAPS AND NEEDS**

How can issues of DRR and CCA be planned together, in order to deal with issues of poverty?

How can integration of DRR and CCA be mainstreamed with development when institutional willingness to do so is lacking?

How can we identify key policies and activities that can be utilized as entry points for the mainstreaming of DRR and CCA?



# Session 63 Challenges in the developing urban world: Informal settlements, slums and growing Inequalities

## SESSION ABSTRACT

Over half of the world's 7 billion people now live in urban areas. As attractive as the city may be for economic, social and political motives, global issues of concern like climate change, environmental health, migration and cyber criminality disproportionately affect urban dwellers more than their rural counterparts. There is growing consensus that the battle for sustainability will be won or lost in cities and that in developing countries it may be best to target the challenge of poverty, which is growing fastest in the cities.

The wealth which cities generate is often held by the minority of urban residents. The vast majority of the urban poor work in the informal sector and live in slums, which are highly vulnerable to epidemics and disasters. The world currently counts over a billion slum dwellers and these slums appear to be the main destinations of new migrants. In the face of environmental changes these areas bear the greatest brunt of phenomena like floods and high temperatures. They suffer disproportionately from the health effects of environmental changes and are more vulnerable to increasing crime and violence. The urban poor have little or no social protection, and rely largely on their own means and on traditional kin-based arrangements and informal social security networks, as the pattern of government spending and social security structures tend to favor formal sector workers more than those in the informal sector. For cities to be sustainable, we need more inclusive and socially equitable policies to reduce vulnerabilities to sudden environmental, social and economic shocks.

*Keywords: informal settlements, inequality, poverty, urbanization, sustainability*

## KEY DISCUSSION POINTS

Growing urbanization in both developed and developing nations is creating inequality and injustice,

including unequal access to resources and services, such as water and sanitation, making urban areas highly vulnerable to risks exacerbated by the threat of climate change.

Challenges remain with respect to how research can be included and discussed with policymakers and planners:

Policymakers often require concrete information (e.g., numbers), thus we need to translate findings in a concise and concrete way or frame it in ways that can piggyback on other issues of concern;

Collaboration and coordination in this research community is key;

Often policymakers in developing countries are not willing to accept or use science given different norms and criteria used for decision making;

Politicians in developing countries often practice politics for the sake of politics only, as the interest is on having power and staying in power, but not in what power can do to improve development; and,

Projects are not often informed by existing research, not participatory and do not respond to the needs of the people.

New knowledge and synthesis is needed and should be on the agenda of Future Earth as well as how to better communicate research to policymakers and incorporate the findings in urban planning and development - this remains a great challenge in need of solutions as well as the willpower of our politicians.

## ORGANIZERS

Humphrey Ngala Ndi, University of Yaounde I, Yaounde, Cameroon

Geoffrey Nwaka, Abia State University, Uturu, Nigeria

Prakash Chandra Tiwari, Kumaon University, Nainital, India

## PRESENTATIONS

**Prakash Chandra Tiwari**, Kumaon University, Nainital, India

Bhagwati Joshi, Government Post Graduation College, Rudrapur, India

*Urban growth and assessment of its natural and socio-economic risks in high mountain ecosystems: A geospatial framework for institutionalizing urban risk management in the Himalaya*

### SUMMARY

Urbanization has emerged as one of the major drivers of environmental changes in the Himalaya. These changes are making urban ecosystems highly vulnerable to a variety of natural and socioeconomic risks, particularly: slope failures, flash floods, urban fires and food, livelihood and health insecurity, all of which affect mainly poor and marginalized communities. Moreover, climate change has stressed urban ecosystems through increased frequency, severity, and intensity of natural and socioeconomic risks. This study developed an urban risk-reduction framework using geo-spatial technology with application through multi-stakeholder governance in Kumaon, Himalaya, India.

### KEY LESSONS LEARNED

Poverty and socio-economic marginalization are responsible for creating urban environmental inequalities in the mountain regions of the developing world under conditions of global environmental change.

There is a great need for the following: (i) comprehensive urban land use policy; (ii) evolving framework for sustainable livelihood for vulnerable sections of the urban population, particularly poor and women; (iii) effective implementation of urban land use plans; and, (iv) development of remote

sensing and GIS support systems with near real-time urban disaster risk assessment and reduction.

In addition to these, gender mainstreaming, particularly through social and economic empowerment of women, and integrating sustainable urban development into an urban climate change adaptation framework are inevitable.

### POLICY/PRACTICE IMPLICATIONS OF RESEARCH

The remote sensing and GIS-based geospatial disaster risk reduction framework evolved through the study will help policy planning organizations and local government agencies in making geospatial decisions as one of the integral components of urban disaster risk reduction strategies in the Himalaya.

The policy recommendations of the research could be extended to different parts of the Himalaya and other high mountain regions of the world in low- and middle-income countries.

This study provides a conceptual basis for urban livelihood improvement and integration with urban risk reduction and climate change adaptation. However, the effective implementation of these outcomes and recommendations would depend on the institutional framework, which is currently weak and inefficient in responding to natural risk and making use of emerging knowledge and technologies.

### KNOWLEDGE GAPS AND NEEDS

The potential of wider application of geo-spatial technology in urban risk governance in high mountains needs to be explored. This includes:

The interpretation of inter-linkages between socio-economic and environmental exclusion and urban sustainability in high mountains;

The assessment of impacts of growing urban inequalities on vulnerability of high mountain urban ecosystems to global environmental change;

The appraisal of the effectiveness and practical applicability of existing policy frameworks for attaining socio-economic equity and environmental

justice in rapidly growing mountain urban areas of developing countries; and,

Exploring prospects and perspectives of improved, equitable urban and climate smart urban governance in mountain regions.

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Humphrey Ngala Ndi, University Of Yaounde I,  
Yaounde, Cameroon

*Regional policy and the growth in slum settlements in developing world cities*

## SUMMARY

In 2007, UN HABITAT estimated that 72 percent of the urban population in sub-Saharan Africa lived in slums. Although the amount of slums is declining in the region, they will persist for a long time because their growth rate remains high. This growth can be attributed to rapid urbanization resulting from strong and persistent waves of rural-urban migration provoked by the failure of regional development policies in many developing countries. Using the case of Cameroon, this presentation showed the relationship between the demise of regional planning agencies and the upsurge in the number of migrants in the country's major cities since the 1990s. It also demonstrated that life in slums has become more precarious; faced with global environmental changes, lower resilience to climate change-related impacts like floods, increased disease vector virulence and heightened cost of disease control and reduced treatments. A return to the pre-1990 regional development policy that ensured ample employment opportunities for the rural population is suggested. This would improve the social and economic characteristics of rural areas while limiting the number of people seeking migration to the towns, thereby reducing the propensity for slums to develop.

## KEY LESSONS LEARNED

In cities in most developing countries, local and central governments are unable to build efficient and healthy urban spaces not only because of the lack of resources, but also due to the multiplicity of

stakeholders involved in urban space management.

Nebulosity, inefficiency and conflicts of competences among stakeholders exist because of overlapping functions, which render coordination expensive and difficult.

The near collapse of regional development policy in developing countries including Cameroon has been a major factor in rapid urbanization, which has now overwhelmed the already weakened capacities of municipal governments to accommodate the influx of migrants. Housing schemes, while 'low cost', are not only insufficient, but are also too expensive and inaccessible to the urban poor.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Rural exodus is the main factor of rapid urbanization in developing countries and can only be regulated by effective regional planning, which gives room for the development of strong and attractive regional economies (both rural and urban) capable of keeping some people from migrating to the biggest or primate cities (a salient feature of Africa's urbanization).

Sustainable planning is an indispensable component of urban and regional development. The demise of development planning in developing countries is a major contributing factor to rapid and haphazard urbanization, which is vulnerable to environmental changes.

Basic elements of good governance equated with democratic virtues like effective political and financial decentralization in developing countries will alleviate the stress that the rural exodus places on the urban space. This includes management of low cost housing and waste, reduction or elimination of squatters, and other public goods that local governments are often under pressure to provide.

## KNOWLEDGE GAPS AND NEEDS

There is the dearth of data required for monitoring spatial changes in urban areas in developing countries.

The gap in the research is mainly methodological.

The use of GIS built from remote sensing data can adequately capture the various themes in the urbanization and global environmental change research framework.

In many developing world cities, the only 'proof' of rapid urbanization lies with the population indices. Many municipal authorities lack in-depth knowledge of the spatial extent and characteristics of their municipalities. Studies that include these data sources and analytic techniques will be of prime importance to the many urban observatories set up by local councils to monitor and report changes in the structure of urban fabric, networks and buildings.

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**Alisson Barbieri** & Raquel Viana, Universidade Federal De Minas Gerais, Belo Horizonte, Brazil

*Natural disasters, urbanization and forced displacement: A Case study on the municipality of Belo Horizonte, Minas Gerais, Brazil*

## SUMMARY

Every year in Brazil, several tragedies occur during the rainy season and/or during periods of severe drought. These events come with serious consequences in terms of human and material losses, especially for the poorest and most vulnerable populations. Given the increasing average global temperature as well as changes in climatic regimes and the characteristics of the urbanization process in Brazil, such events have become more frequent and more intense. The 'environmental refugees' label has been used to refer to the process of forced displacement of this vulnerable population, despite the lack of consensus in the political or academic arena about the suitability of the concept and its ability to politicize/depoliticize the problem. This presentation investigated the theoretical construction and relationship between the concepts of 'forced displacement', 'extreme weather events' and 'vulnerability', and analyzed them in the context of urban areas in Brazil. The population living in Vila Betânia - a small slum located in an at-risk area in Belo Horizonte, Brazil was utilized as a case study.

## KEY LESSONS LEARNED

This research indicates three important issues related to disaster risk prevention and mitigation policies in urban areas as well as the promotion of environmental justice and development:

There are a multitude of risks and needs among families in the case study area, such as the precarious housing and poor access to the formal housing market, unemployment, displacement costs, crime and urban violence, the risks related to natural disasters and global environmental change.

The removal of the population from at-risk areas in cities is an adaptive and mitigative policy response to natural disasters, as it removes the immediate risk of flooding or landslide. However, it will only be effective as an action or development policy to reduce social and environmental inequalities if the spatial displacement of the vulnerable population does not result in reduced quality of life for these families in public safety, maintenance of support networks, employment, provision of health and education services, urban mobility, etc.

Post-disaster emergency measures require a quick and agile response of the state and society. Policies of removal should take into consideration the timing required for preparing the removal of the families. The delay in execution of infrastructure projects often implies the obsolescence of the projects.

## POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Although in some municipalities, emergency measures (mitigation actions) are taken with some agility, adaptation measures still take too long to implement. Delays are one of the main aspects related to the ineffectiveness of public responses to natural disasters.

The second policy implication is related to the different types of procedures and principles that guide public institutions and have considerable impact in people's process of removal.

The multiple aspects of vulnerability require interconnected and intersectoral policies, in order to improve human well-being. If the direct removal of families can eliminate the immediate risk of flood, this displacement can also magnify or create new risks such as increased insecurity and urban violence.

Transparency, communication and the participation of affected communities are crucial aspects of a successful policy addressing forced displacement.

### KNOWLEDGE GAPS AND NEEDS

More studies are needed to understand the importance of social networks in the context of vulnerable people in urban areas and the impact that removal or displacement has on the social network (size, composition, etc.) of vulnerable individuals and families.

Disasters and the expropriation of commercial properties often produces impacts on families of small proprietors, in which public policies to reduce and prevent risk have not had a direct effect. This situation suggests that the disaster in one place can impact families residing in other regions in an indirect manner.

More studies are needed to better qualify the demographic vulnerability framework.

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Aliyu Kawu, Federal University Of Technology,  
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*Climate change, urban management and livelihood challenges in low income neighborhoods of developing countries*

### SUMMARY

The increasing rate of urbanization in developing countries has long attracted the attention of urban managers and environmentalists across the globe. Shortages arising from limited finances for urban facilities have increased the need for efforts by resident groups such as Community Based Organizations (CBOs). Although demographic change and the accompanying negative consequences

have characterized poorly served enclaves of burgeoning cities, intervening organizations have largely deemphasized peculiar self-help efforts in the increasingly diverse segments of low-income cities. This presentation explored the extent to which urban facility provision and management by ill-served urban residents has been able to tackle lingering challenges of life and livelihood in cities of the Global South.

### KEY LESSONS LEARNED

The urban poor continue to form associations to address inadequacies in sanitation, environmental management and adequate provision of facilities.

CBOs have created different avenues for funding community self-help projects through different modes of self-finance; the majority of these groups receive no input or assistance from the government.

There are hardly any urban development projects executed by the government in full collaboration with CBOs; avenues for collaboration between CBOs and other partners in development are rarely explored.

### POLICY/PRACTICE IMPLICATIONS OF RESEARCH

There is a strong need for institutional reform to accommodate community organizations.

Policy implementation often suffers due to lack of recognition by the government to the contributions of CBOs.

CBOs are more effective in dealing with local issues than governments and external organizations as well as addressing climate change and other related issues

Community organizations should be on the boards of government ministries and local government agencies

### KNOWLEDGE GAPS AND NEEDS

There is the need for additional data on what constraints exist that limit collaboration of CBOs with outside organizations including sister organizations and public agencies.



The availability of accurate data is a complex problem and deserves further attention. The dearth of spatial data has in many instances thwarted studies of the spatial distribution of CBOs, and is further constrained by the limitations imposed by the lack of geo-referenced maps desired by donors and beneficiaries for effective intervention.

There is the need for further research on the localization of democratic processes and principles in leadership.

A study is needed to establish a process of integrating CBOs in formal urban administration and management.

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*Methods and tools for equitable and sustainable cities: Implications for infrastructure systems and policies that integrate diverse populations*

## SUMMARY

This presentation shared results and proceedings of a four-day interdisciplinary workshop led by Ph.D. and post-doctoral students from engineering, architecture/planning, public policy, public health and environmental science programs at eight U.S. universities and research institutions. A key workshop aim was to identify methods and tools to address the synergistic goals of equitable and sustainable cities, with funding support provided through a United States National Science Foundation Research Coordination Network on Sustainable Cities that focuses on reducing energy use, emissions and climate-risks to water supply and public health in cities. The cases presented were from cities planning for sustainability

and climate change while also aiming to overcome recent rapid urbanization and historical geographic marginalization. The cities compared illustrate different methods and tools for advancing sustainable city goals while also addressing inequities.

## KEY LESSONS LEARNED

Important social equity challenges exist globally.

There is growing recognition that urban sustainability efforts need to take social equity seriously or else may exacerbate existing inequities and increase risks to the economy, environment and society.

New methods and tools are now available for improving the gap between academic research, community engagement on sustainable cities and implementation of actions toward addressing existing urban inequities.

Preparing our world cities for reducing resource use/emissions and addressing the increasing risks associated with climate change and various other acute and chronic stresses is an urgent necessity. Doing so in a way that promotes social equity (including gender equity) will provide a double dividend of more inclusive and robust city plans and empowerment for marginalized and vulnerable populations.

## KNOWLEDGE GAPS AND NEEDS

Four U.S. case study cities from author's city residences (Denver, Boston, Phoenix, and Tallahassee); and four global cities (Mumbai, India; Medellin, Colombia; Lima, Peru; Nairobi, Kenya) illustrate examples of how cities are working together with diverse actors on engineering, planning, policy and behavior change for addressing urban sustainability and climate change while also aiming to overcome recent rapid urbanization and historical geographic marginalization. Some cities have been more successful than others, but why? Key knowledge gaps lie in exploring the extent to which synergies and trade-offs exist with local actions in this context and in defining/measuring the diverse

aspects of sustainability and equity to prioritize actions / monitor outcomes over time.

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Dieu Linh Nguyen, GIZ, Vientiane, Laos

Rethinking improved access to sanitation for the urban population in a changing climate? An analysis of the urban poor in slum areas in toward explaining variation in access to improved sanitation

### SUMMARY

Little attention has been paid to the inequality of access to improved sanitation between the urban poor and the urban non-poor. In a progress report on drinking water and sanitation issued by WHO and UNICEF in 2010, there is no mention of the issue of inequality in access to improved sanitation in urban areas. The current reports that show relatively high average percentages of urban populations provided with better sanitation facilities may be misleading. There is a lack of statistical analysis on the variation of access to improved sanitation between the urban poor living in informal settlements and the urban non-poor. This is surprising as the UNDP Human Development Report reveals that access to improved sanitation lags far behind access to water and is off-track to meet the Millennium Development Goals on both. This presentation contributed empirical evidence on the relationship between urban populations and access to improved sanitation controlling for urban populations living in slums.

### KEY LESSONS LEARNED

Africa is among the most off-track with respect to the Millennium Development Goals (MDGs) on sanitation.

The percentage of population in urban areas is not an adequate predictor of improved access to sanitation.

Current data on improved sanitation coverage, particularly in urban areas, is exaggerated due to incomplete data on the millions of people living in slums.

### POLICY/PRACTICE IMPLICATIONS OF RESEARCH

Urban slum dwellers are often not represented in census data; this must be addressed when global assessment reports are prepared.

Livable cities initiatives and the new Sustainable Development Goals (SDGs) must address urban sanitation in slums.

### KNOWLEDGE GAPS AND NEEDS

As most studies in the literature are qualitative and not at the global scale, more statistical evidence is needed to explain differences (intra-urban and city-city) in access to improved sanitation of the urban poor.

More research and comparative analyses are needed on urban slums and sanitation in developing countries – especially at the global scale and in the context of climate change.

How can global assessment reports more adequately reflect the real situation of urban access to improved sanitation?

How can there be greater equity in communicating the results of the research to the public and policymakers?

How can the SDGs openly address sanitation in slums?

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## Urbanization and Global Environmental Change

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