UGEC VIEWPOINTS

Urbanization: A Critical Human Dimension of Global Environmental Change

Editorial

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Dear friends of the UGEC project,

The current issue of the *UGEC Viewpoints* was conceptualized at the end of the 7th Open Meeting of the International Human Dimensions Programme on Global Environmental Change which was held in Bonn, Germany between April 26-30. The conference was deemed a great success with nearly 1,000 participants including researchers, NGOs, practitioners, and decision makers in attendance for the four-day conference and more than 100 sessions. The Open Meeting clearly demonstrated that humans and societal challenges are now and should continue to be at the forefront of the global environmental change research agenda.

For the UGEC project it was clear that the interest in the theme of cities and urban areas has, more generally, "taken off" in the last few years. It was a great pleasure for us to see a significant portion of the sessions devoted to the theme of urban areas. This issue of *UGEC Viewpoints* highlights a few of the papers presented and discussed at several Open Meeting sessions, pinpointing a wide array of social challenges present in urban areas across different world regions. We hope that you will enjoy reading the issue as much as we enjoyed putting it together.

The next years of research in the field of Urbanization and Global Environmental Change promise to be exciting and will bring about significant findings for the enhancement of human wellbeing in urban settlements. Contributing to this goal, the UGEC project is currently planning its first International Urbanization and Global Environmental Change Science and Practice Conference for Fall, 2010 (please see the inside back cover). As the planning process moves forward, we will be circulating more details and information about participation and how to submit your abstracts – so don't forget to join our mailing list for relevant news!

Best regards,

Michail Fragkias

Michail Fragkias
UGEC Executive Officer

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Uttar Pradesh, India

Introduction to the Issue
Corrie Griffith

Urbanization is a global phenomenon that has transformed and continues to alter landscapes and the ways in which societies function and develop. Currently, more than half of the world's population lives in cities; the United Nations projects that by 2030 the world will advance to the 60% urbanization threshold. Rapid urbanization effects will not only be present within the immediate locations (cities and their metropolitan areas), but will be experienced regionally and globally. The UGEC project seeks to better understand these implications and the complex dynamic systems of urban areas that affect and are affected by global environmental change (e.g., climate change, natural disasters, loss of biodiversity, freshwater ecosystem decline, desertification, and land degradation).

Earlier this year, the 7th Open Meeting of the International Human Dimensions Programme on Global Environmental Change held in Bonn, Germany showed the increased emphasis on the role of humans in global environmental change research – also recently acknowledged by the IPCC's AR4. A better understanding of the emerging challenges has sparked greater efforts towards research that includes a wide-range of disciplines, is policy relevant and pragmatic, and is communicated more effectively with governments, businesses, NGOs, and the general public. In this light, the conference addressed the current challenges associated with the human dimensions of global environmental change, focusing on the role of human beings, not only as contributors to, but also as actors able to frame problems and devise solutions for overcoming them.

Four social challenges – demographics; resources and technological innovation; social equity, cohesion, and sustainable adaptation; and adaptive institutions and governance – were identified by the International Scientific Planning Committee as the most critical for sustaining healthy livelihoods and good entry points for discussing and advancing new research. With each topic as the daily theme running throughout plenary, parallel, and special session discussions, the human dimensions research community was provided a number of platforms to debate, share and take ideas forward, and to initiate new research collaborations. Sessions highlighted the interconnections that exist between specific issues of primary focus to IHDP such as water, land, food, climate change, coastal zones, institutions, technology or urbanization and one or more of these four social challenges. It quickly became clear that urbanization is increasingly becoming a high-priority issue for the human dimensions of global environmental change.

For this issue of *UGEC Viewpoints* we collected case-studies presented at the Open Meeting that span across regions and themes: from Australia and the United States, as well as the less developed nations in Africa, megacities of Asia such as Dhaka, Bangladesh and Delhi, India, vulnerable coastal areas of the Yucatan Peninsula, and the largest rainforest in the world, the Brazilian Amazon. Several commonalities are readily identifiable in the authors' research, some of which include an attention to the roles of the governance structures within cities; the functioning of ecosystem services, water, food, and sanitation service provision; as well as the role of research in assisting the successful development of sustainable urban plans and policies.

This newsletter includes ten articles, the first of which highlights the capacities of governance structures in the megacity of Delhi. Here, Aggarwal notes that these structures, along with the actors and institutions, particularly in cities of the developing world, are not well understood. She explores these structures, the nature of local citizen participation and public-private partnerships within Delhi. Guiding her research is the underlying question of whether cities will be able to meet the expectations of the global community of taking effective action on global environmental change.

Following this theme, Zimmer, Etzold and Keck reveal how intricate and complex governance structures are within megacities, and why their understanding is so important, particularly for the development of successful urban management plans. While the former investigates sanitation service provision in the slum and squatter settlements of Delhi, the latter two highlight the

importance of the "production of space" or "place making" for understanding how people self-govern in the absence of formal governance structures in the city of Dhaka. With ongoing rural-urban migration, often induced by global environmental change, service provision and other infrastructure are often inadequate or unavailable for all residents living within these cities. Using the framework of a "waterscape", Zimmer discusses the highly contentious and political nature of sanitation service provision and finds that what is actually taking place on the ground is quite different from what is "officially" sanctioned. She investigates the social relations of wastewater governance, revealing not only who is providing the services, but also how these services are provided. In their piece, Etzold and Keck ask questions of who gets access to certain spaces and how these spaces are utilized in the case of street food vendors, in order to better understand the megaurban food system of Dhaka.

The fourth and fifth contributions by Hughes and York et al. offer examples of research that is taking place in the United States and Australia. We know that urban growth creates challenges for sustainable resource management, and adapting resource use to changing ecological and social conditions as a result of climate change will be of great importance. Hughes offers a look into the urban governance of recycled water in the state of California and in Australia. While both regions share quite a few similarities, Australia has proven more successful in its provisioning of recycled water for residential use. Asking why this is the case, Hughes suggests that institutional features may be responsible for enhancing the development of such policies. More broadly speaking, knowing what these successful features are could help the integration of sustainability into the planning of cities around the globe.

In York et al., the authors present results from a pilot study conducted in Phoenix Arizona, part of a larger body of research, which is investigating how landscape fragmentation affects ecosystem services. They employ Long Term Ecological Research cross-site analysis within the U.S. that explores the relationship between landscape fragmentation and the magnitude and rate of change of water provisioning, population growth, and urbanization. Their research will provide valuable knowledge into the understudied dynamics of social and ecological systems.

Next, Guedes et al. and Pelling et al. study regions that include rainforest and marine coastal areas that are among some of the most ecologically rich and diverse landscapes, as well as some of the most vulnerable to human impacts and global environmental change. In the Brazilian Amazon, urban development is rapidly increasing, the consequences of which can be devastating to the natural environment. Whereas research has focused more on rural areas, here Guedes et al. present research into the nature of cities and urbanization processes. Using specialized models, they analyze urban growth, development and urban hierarchies at three levels – the regional, sub-regional and local. This research adds to the limited knowledge of urbanization dynamics in this region and helps the understanding of the social and economic interconnections that exist, important for enhancing regional planning and conservation efforts.

Pelling et al. use tools from both resilience and transition theory to analyze the capacities of the coastal cities of Mahahaul and Playa del Carmen in the Mexican Caribbean. These make for interesting cases, due to the rapid socio-ecological change that is occurring as a result of the strong influence of international tourism. They offer a different perspective to the literature on climate proofing by giving attention to the cultural, social and political aspects that underlie adaption planning policy.

Finally, Lwasa describes the many challenges that confront the cities and urban centers of sub-Saharan Africa, which are intensified due to climate change vulnerability. It is clear that rapid urbanization in the region has led to a number of devastating consequences, including poverty and the lack of infrastructure and social services. He discusses the drivers of urbanization and the issues and conflicts that have arisen, while making suggestions for future urban sustainable development policies. Following this, two short articles by Olorunfemi and Fayomi provide additional perspectives on the challenges confronting African countries.

While each article highlights a unique set of challenges dependent upon the respective region and its geophysical characteristics, existing political and governance systems, infrastructure, service provision capacities, culture, and economic structure, also present are unique opportunities for overcoming these challenges and rethinking urban development globally. A better understanding of how cities function as social systems and how they interact with and influence economic and environmental systems will not only further advance the knowledge base of urban dynamics, but taken to the next step, can assist policymakers and practitioners with designing better, more sustainable cities in the face of global environmental changes.

Daily commuters in Delhi, India

Reexamining the Capacity of Cities as Agents of Global Environmental Change: The Case of Delhi

Rimjhim Aggarwal

Cities are increasingly being viewed as the loci of action on global environmental change. Given that cities are the primary contributors to (and often victims of) environmental change, this focus seems natural. However, from the standpoint of undertaking effective action – often of a transformative nature (as is increasingly being expected of cities) – there is the need to examine whether the underlying structure of governance of cities is consistent with this kind of expectation. The extent to which cities will be able to meet the challenge of binding resource constraints and climate change will depend critically on the autonomy, capacity, and flexibility of their local institutions. For cities in the developing world, in particular, we understand very little about the actors, institutions, and the regulatory framework at the city level (as opposed to the national level) and how these are nested within institutions at higher levels.

Two independent (but related) processes working at the global scale are fundamental in our understanding of recent changes in governance of cities in the developing world. The first is globalization which implies economic fusion and the emergence of networks of world cities as the primary arena for action on global environmental change. The other is the drive towards decentralization, which aims to devolve more decision making authority at the local level, away from the national and regional levels. To a certain extent these processes are linked. As Harris (2003, pg. 2542) observes, "economic fusion, it seems, has stimulated political fission" (in the form of decentralization). In his view, globalization is thus "liberation for cities" (ibid.).

While this view may be justified for some cities in the developed world, for most cities in emerging economies the sovereign national state has been reluctant to relinquish its control of the local - particularly in the critical areas of city planning and fiscal affairs. Thus, while the trend towards globalization has enhanced the image of high-growth metropolitan regions in developing countries as "global cities" - with the expectation of world class quality of basic services - this has not been matched with a concomitant increase in the capacity of urban local bodies to meet these expectations. The case of India - with its wide array of global cities - is particularly illuminating in this respect, as we discuss below.

> **The concept of "cities as agents of change" is certainly interesting and potentially relevant for cities in the developed world. To what extent can the same be realistically expected from cities in the developing world which are still struggling to match the capabilities of their political and administrative institutions with their growing economic dominance?**

Capacity of Urban Local Bodies in India: Expectations versus Reality

A landmark event in the history of urban governance in India is the passage of the Constitution's 74th Amendment Act (CAA) in 1992, through which municipal bodies were provided the Constitutional Status of the third tier of government (earlier it was central, state and concurrent). The CAA left it up to the Legislature of a State to decide which powers and authority it may devolve on a municipality. In reality, most states in India have been reluctant to relinquish their control over fiscal matters. Thus, although the CAA lays out a large range of local taxes, fees, and tolls to be levied by the Urban Local Bodies (ULBs), in practice the ULBs have imposed only a few of these (Bagchi & Chattopadhyay, 2004). As a consequence, the ULBs have not been able to generate the resources needed to meet the requirements of their growing responsibilities.

Lacking adequate capacity to raise revenues on their own, city governments have largely been dependent on budgetary allocation from higher levels of governments. In recent years, however, large current account deficits at both central and state government levels are forcing city governments to look for alternative sources of funding through public-private partnerships and capital market funds. A closer examination of these initiatives across different cities in India reveals that it is only the relatively large cities that have been successful in attracting this sort of funding (ibid.).

Ironically, while city governments are being pressured to raise their own resources for provision of basic services, they have very limited autonomy with respect to the planning and management of these services. Even for large cities like Mumbai, the planning and management of basic services falls under various ministries that have state-wide responsibilities and constituencies as opposed to an elected body of local representatives who are

responsive to local needs. Phatak and Patel (2005) examine how this lack of capacity and autonomy at the local level impacted the recovery effort during the 2004 floods in Mumbai and how the response may have been different under a more decentralized form of governance.

Thus, to summarize, while the intention of the CAA was to move towards a decentralized system with municipalities functioning as institutions of self government, this has not been realized in practice. The degraded state of basic civic services and the rising frustration of the urban middle class have found instead a different outlet. This follows from the widespread global rhetoric on the potential of local citizen participation as a panacea to the problems of urban governance. In the next section we discuss the case of a new initiative on citizen-civic agency partnership in metropolitan Delhi and its implications on urban governance and the potential for environmental change.

Citizen Participation and Urban Governance in Delhi

The metropolitan region of Delhi is referred to as the National Capital Region (NCR) of Delhi. It consists of the Union Territory of Delhi (also referred to as the National Capital Territory, or NCT of Delhi) and a few ring towns around it that fall under the jurisdiction of three different states as shown in Figure 1. These ring towns were conceived as part of the Delhi Master Plan back in 1962 to reduce the population pressure on the city core. Although these ring towns have witnessed the highest population growth and have absorbed most of the immigrant flow, in terms of governance, these represent a major challenge. About 20-25%

Figure 1 | National Capital Region Regional Plan 2001 Constituent Areas

Source: http://www.thaibicindia.org.in/study/delhi/Overview_of_Delhi.pdf

of the population in NCT of Delhi is estimated to live in slum and squatter settlements. Most of these people live in hazardous sites and are exposed to multiple environmental health risks.

Following the CAA and in response to the rising frustration of citizens with provision of basic services, the Government of NCT of Delhi launched a major initiative in 2000 called the "Bhagidari" (or partnership program) to empower the citizenry to look after local civic problems at the community level in collaboration with civic agency officials.[1] The program created a formal system of liaison between residents, civil society organizations, and relevant government departments. The areas of consultation and sharing of responsibilities under the program include: rainwater harvesting, water and energy conservation, solid waste management, greening of Delhi, control of air pollution, and environment awareness campaigns.

As part of the program, several workshops are organized to train citizen groups and government officials to come together to discuss problems and brainstorm ideas in order to come to consensual solutions. Regular meetings are also held among the concerned departments and Deputy Commissioner Officers to implement and monitor solutions. Resident Welfare Associations (RWAs), formed at the neighborhood level, are the primary citizen groups under this program. Since the inception of the program in 2000, the number of RWAs in NCT of Delhi has grown from 20 to around 2000. In a city infamous for its bureaucracy and red tape, the RWAs now have a say in how the money is spent in their areas and how to hold the local officials accountable.

An important consequence of this program has been that it has moved at least the city's middle class from cynicism to active participation in local governance. Thus, the program plays an important role in bridging a perceived democratic deficit and has improved the accountability, transparency, and responsiveness of urban local bodies to the citizenry. However, it needs to be kept in mind that the Bhagidari program lacks statutory authority. An important criticism of the program is that it has created a parallel system of government, instead of strengthening the capacity of the existing structure of governance.

Another major problem is that the funding available under the Bhagidari program, even for small-scale community projects, is generally inadequate and the RWAs primarily depend on contributions from their members. This aggravates the underlying structure of inequities in the city, as the richer neighborhoods are able to collect enough funds to self-finance community projects often at the cost of surrounding poorer neighborhoods. As shown in Figure 2, groundwater depletion is a major problem in parts of south Delhi. Decentralized governance under the Bhagidari system has meant that richer neighborhoods in these areas have been able to invest in deep borewells to cope with problems of inadequate and uncertain supply from the municipal system, while increasing the vulnerability of surrounding poorer neighborhoods and jeopardizing the sustainability of the system.

Figure 2 I Decline of Ground Water Level in NCT-Delhi
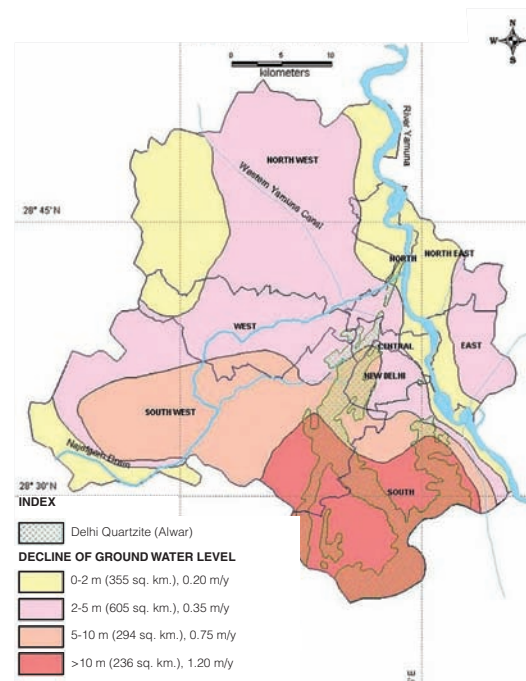
Source: Central Groundwater Board, Delhi Year Book 2006

Thus, to conclude, citizen participation in urban governance holds a lot of potential, particularly in terms of its role in filling up the democratic deficit. However, there is nothing intrinsically transformative about participation or about its pro-poor outcomes. The potential of participatory programs has to be seen in the wider context of institutional and political configurations within which it is embedded, as elaborated above. Unless the capacity of elected urban local bodies is strengthened and their incentive structure is better aligned with the needs of citizen groups, participation by itself is unlikely to bring about any fundamental transformation.

The references for this article are available on our website: http://ugec.org/docs/ViewpointsIssue2References.pdf

[1]Taken from the website of the Government of NCT of Delhi (accessed April 15, 2009): http://delhigovt.nic.in/bhagidari.asp

Wastewater drains in an unauthorized colony

Social Relations in the Waste Waterscapes:
The Case of Delhi's Informal Settlements

Anna Zimmer

Early in my investigations[1] of waste water governance in Delhi slums, I was struck with the difficulty of identifying the responsibilities of the Municipal Corporation of Delhi (MCD), the Urban Local Body whose jurisdiction includes sanitation services (Ghosh & Tawa Lama-Rewal, 2005). In an interview with an officer from the MCD "Slum and JJ-Department" (the department dealing with informal settlements), he denied that sanitation was part of his tasks: *"We are not providing [any sanitation service in the slums]".* He explained that waste water channels and drains were built and maintained by the Department of Environment Management Services (DEMS) of MCD. Moving on to the DEMS offices, however, I learned that *"slum clusters are exclusively dealt with by the Slum Department, even the drainage […]. There are territories which have been defined; within their [Slum Department's] territory we do not go."*

However, several weeks of fieldwork revealed that sanitation services were being provided to the slums – regularly, and through the officially appointed scavengers of the wards in which the settlements are located. Despite an administrative black hole, services did reach the ground. This intriguing observation provoked my interest for further inquiry into how and by whom the waste water governance in Delhi is in fact set up. In order to understand this set up, I discuss actor relationships in two distinct "waste waterscapes"; of particular interest here are the relationships between slum dwellers and scavengers and interactions between residents and their elected representatives. The article is based on research findings from qualitative and participative methods undertaken in two slums as well as from interviews with key actors carried out between October 2008 and February 2009.[2]

Political Ecology of Waste Waterscapes

In recent years, the urban environment has been addressed by a growing number of publications within the field of Urban Political Ecology (among others, Forsyth, 2004; Keil, 2003; Keil, 2005; Pelling, 2003; Swyngedouw, 2004; Véron, 2006). Urban

Slum dwellers are exposed to open wastewater on a daily basis

Political Ecology is grounded in an understanding of the city as a co-produced outcome of processes from the societal as well as the natural realm. Within this strand of inquiry, Swyngedouw (2004) has described socially contingent water realities in the city with the term "waterscape". Highlighting the waterscape's produced character allows for one to look into the historical trajectories and temporal dynamics which are shaped through negotiation processes between actors. Like the landscape, the waterscape may be "read" in terms of power struggles over the interaction that actors have with their environment (Bryant et al., 1997). As such, waterscapes are understood to be highly politicised. In my project, this concept is used to investigate the waste water related practices of actors as embedded in social relations.

Micropolitics in the Waste Waterscapes

As already noted above, official sanitation approaches taken by Delhi's city administration do not necessarily translate to the reality on the ground. As sanitation services are organised at ward level, a certain amount of discretion allows the appointed DEMS staff to interpret rules and regulations (Tarlo, 2001[3]). Moreover, the agglomeration of 16 million inhabitants (UN Department of Economic and Social Affairs, 2007) is characterised by a heterogeneous pattern of colonies: while authorised areas house 23% of Delhi's population, slightly higher numbers live in squatter settlements - so called JJ clusters, (24%), and unauthorised colonies (UACs) (26%) (WaterAid India, 2005). Both are officially termed "slums" (Ali, 2003), but while the demolition of JJ clusters is continuing with resettlement taking place at the outskirts of Delhi, (Dupont, 2008), UACs are in the process of being legalised.

Three factors, the distance between higher and lower ranks of the administration, the organisation at ward level, and the diversity of colonies translate into locally specific arrangements in which sanitation services are, or are not, being provided. As such, waste waterscapes are a localised phenomenon. Power in these waste waterscapes is decentralized, leaving the governance of waste water to be contested in multiple local struggles, a form of micropolitics (Foucault, 1980). The outcome is a heterogeneous pattern of infrastructure, related practices and subsequent problems (Zimmer, forthcoming). Analysing these problems requires a focus on the people's interaction with the state through their everyday encounters with their representatives in the ward (Brass, 2006; Corbridge et al., 2005; Fuller & Bénéï, 2001; Oldenburg, 2006). Negotiating public service provision takes place within networks of actors including the administration, the political representatives and inhabitants.

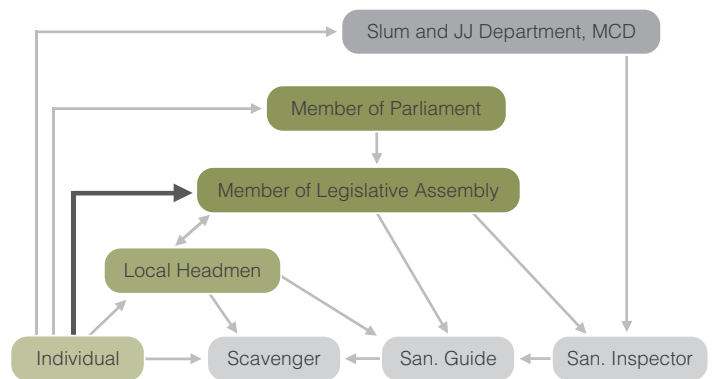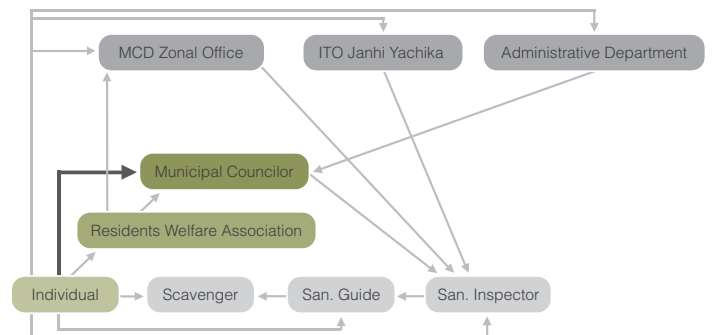**Figure 1** | Service Provision Network in the JJ Cluster

Figure 2 | Service Provision Network in the Unauthorized Colony

[3] Tarlo describes how in a similar manner local government officials had the possibility to interpret regulations concerning resettlement policies in India, pointing to equally localized solutions.

Networks of Service Provision

In comparing a JJ cluster to a UAC, it becomes apparent that the networks of service provision are different for both types of slums (see Figures 1 & 2). Service is provided to both slums by public scavengers. Inhabitants seeking to maintain and improve service delivery, therefore, interact with them directly. If this is not successful, slum dwellers have to use their links to other more powerful actors to "get the work done" by the scavengers. In both cases, addressing their political representatives is the most promising strategy for residents. Yet, while the UAC is in contact with the Municipal Councillor (MC), responsible for sanitation related issues in the ward under the MCD, the JJ cluster is linked to the Member of the Legislative Assembly (MLA), a representative at the State level. Although sanitation is not officially his duty, the MLA is actually related to the MC and so takes over some of his responsibilities. Moreover, inhabitants of the JJ cluster focus on addressing local staff of the city administration about service delivery, whereas members of the UAC are aware of a number of options to pursue that exist higher up the bureaucratic hierarchy. Like the configurations of the networks, social relations within the networks are not the same. In the following, the interactions with scavengers and political representatives will be discussed.

Social Relations in the Network

While the network of service provision illustrates who is actively engaged in providing service to the slums, it is the social relations which determine how service provision is achieved. Negotiations of waste water governance take place through communication in everyday encounters. They can reproduce the status quo as well as challenge it. Against this background, the provision of waste water related services or lack thereof depends on multiple decentralised decisions within that network, with each interaction contributing to the final outcome. Like citizens, state employees can prove more or less powerful in these interactions (Oldenburg, 2006).

In the investigated cases, the stability of power relations is not the same in both colonies. Inhabitants of the JJ cluster have a

similar status to the scavengers in terms of education and income, which opens up the floor for a constant challenging of duties and rights. In the UAC, the status of inhabitants is significantly higher than that of the scavengers in terms of education and caste. Scavengers, therefore, face difficulties in challenging the role assigned to them by the citizens.

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A public scavenger working to pick up trash in the squatter settlement

The opposite case presents itself concerning the relationship between political representatives and slum dwellers. While interaction is more fixed for inhabitants of the JJ cluster, it is more flexible for UAC residents. This is due to two factors. First, the JJ cluster represents only a small fraction of the MLA electorate, so that an inhabitant's ability to challenge the role of his or her representative is limited. In the case of the UAC, the whole ward is constituted of unauthorised areas; therefore, the MC has no other voters to rely on. Second, the social status, in terms of education and income, are strikingly different than those within the JJ cluster. This leaves slum dwellers with little power to challenge the MLA's influential role. Meanwhile, in the UAC, the MC is a woman of the unauthorised colony itself, so that any difference in status depends exclusively on the powers her neighbours have vested in her. As her status depends on their goodwill, she cannot use her power as freely to deny inhabitant's requests.

Direct communication can be understood as a means to negotiate the described relationships, in terms of either reproducing or challenging them. Accordingly, forms of communication and the arguments used by residents to convince scavengers and

political representatives are different in both settlements. In terms of direct communication with the scavengers, JJ cluster dwellers complain to them regularly and accuse them of not fulfilling their assigned duties. In this context, caste based reputations or prejudices are used by inhabitants to legitimise their claims to the scavengers. Moreover, inhabitants can put scavengers down referring to their job as "dirty". Although scavengers are members of the administration and are supposed to serve the citizens, they can argue in return that their government job gives them a better understanding of the waste water situation. Also, being employed by the state connotes a higher status than that of slum dwellers, referred to as "beggars" by scavengers. In the UAC, however, inhabitants rarely communicate with the scavengers directly, but rather complain to their political representative.

Concerning the relationship with politicians, it shows that with high power divides, inhabitants are reduced to supplicating (Corbridge et al., 2005) their representative to act in their favour or complain, if they have a higher social position. Residents of the JJ cluster, then, move between supplicating and complaining, using moral arguments more often than democratic ones. As constituents, this does put pressure on the MLA, but he is barely responsive to these arguments outside election times. In the UAC, residents more often complain to the MC, making democratic claims to their rights as citizens. She is regularly reminded through these arguments of the fact that she owes her post to them.

Conclusion

In order to understand the waste water situation in Delhi slums, sanitation practices of inhabitants and the state need to be understood as embedded in a set of social relations conceptualised as a waste waterscape. It has been shown that waste waterscapes in Delhi are a localised phenomenon where sanitation related services under the authority of the state have to be constantly renegotiated by the slum dwellers. This negotiation takes place in interactions between citizens and the "everyday state" (Fuller & Bénéï, 2001) at ward level.

A street in Delhi

There are two striking differences between the investigated settlements. First, roles and subsequent duties are constantly contested between inhabitants of the JJ cluster and the scavengers. Meanwhile, in the UAC, scavengers and residents hardly interact concerning these issues, pointing to more stable roles. Secondly, in the JJ cluster, interaction is reproducing the power divide between inhabitants and the MLA. His status is recognised by slum dwellers, and most inhabitants equally accept that they have to keep supplicating for his assistance. In contrast, UAC dwellers can easily challenge the MC's status as their representative in each new encounter, which keeps the power relations in a state of flux.

These findings have consequences for the waste water realities people face on the ground in terms of quality and quantity of the service provided. Yet, waste water realities appear to be dependent on an even greater degree of negotiation processes between the city administration and political representatives of slums; importantly, these processes decide over the level of provision of infrastructure, allocation of scavengers, utilisation of funds, and technical means of service provision. Investigation of micropolitics at that level continues during a second period of fieldwork from July to December 2009.

The references for this article are available on our website: http://ugec.org/docs/ViewpointsIssue2References.pdf

Dhaka, Bangladesh

Politics of Space in the Megacity Dhaka: Negotiation of Rules in Contested Urban Arenas

Benjamin Etzold & Markus Keck

Hardly any other city in the world has been growing as rapidly in the last few decades as the capital of Bangladesh. Today there are 14 million people in Dhaka: 34 times more inhabitants than in the 1950s (UN, 2008). This growth has occurred largely due to ongoing rural-urban migration, which is often triggered by environmental change.[1] Thirty to forty percent of the megacity's population live in marginal, partly illegal settlements and under conditions of extreme poverty (World Bank, 2007). The provision of basic amenities like drinking water and sewerage systems for all inhabitants is beyond the capacities of the city's administration, as is the creation of secure employment in the "formal" economy. Nevertheless, vulnerable populations in Dhaka manage to sustain their livelihoods in innovative and flexible, however, precarious ways for instance, by involving themselves in the informal "street economy".

The combined effects of rapid population growth, spatial expansion, environmental change and the complex local impacts of the global political economy, thus, go hand in hand with malfunctioning formal governance structures, spatial fragmentation, socioeconomic polarization and political struggles. Many of these conflicts evolve around the "production of space" (Lefebvre, 1991), in terms of the access to, use and appropriation of settlement areas, streets and market places.

In this context, the question of urban governance, its quality and spatiality, becomes an urgent one (Siddiqui et al., 2004). The prevailing mode of governance is understood as a set of institutions, which actors in urban arenas accept as legitimate and concordantly align their actions (Etzold et al., 2009, pg. 7), whether these are spatial practices or other social interactions. In our research, we combine such an actors-oriented governance approach with the notion of the "production of space" (Lefebvre, 1991) or "place making" (Werlen, 1997) in order to detect spatial connotations of urban governance. Three key questions guide our analysis:

1. Who gets access to a certain space, for instance to a food market? (*access to space*)
2. Which spatial practices are applied by actors in these spaces? (*use of space*)
3. How and by whom is governance of space negotiated, contested and legitimated? (*appropriation of space*)

[1] An even further increase of environmentally induced (temporary) migration to Dhaka is projected as Bangladesh is expected to be one of the countries most severely affected by climate change effects (Poncolet, 2008; Moser, 2009; Warner et al., 2009).

Our analysis mainly draws on case studies from ongoing empirical research into the megaurban food system of Dhaka (Keck et al., 2009).[2] Here we present one which exemplifies the access to and the use of public space by street food vendors.

(In)formal Institutions, Conflicts, and the "Production of Space"

In contested arenas many actors with divergent interests, unequal power positions and different capabilities constantly challenge the operating "rules of the game" (North, 1990). Given the ineffectiveness and often inappropriateness of state and municipal law, informal modes of governance, largely based on highly personalized networks, are often more efficient and pervasive. These sets of informal institutions manifest themselves in the structure of the local (not only "informal") economy and in such spatial arrangements that are beyond recognition and – most often – beyond the control of state authorities (i.e. squatter settlements, unauthorized markets, vending sites on streets and other public spaces). These arenas – understood here as the social "fields" in which actors are relationally positioned according to their different capacities and their respective positions of power (see Figure 1) – are constantly (re)produced by the actors themselves (Werlen, 1997; Bourdieu, 1998). Therefore, the rules that are in effect are often contested and highly dynamic; they can change not only over the course of years, but within a single day.

Figure 1 | Schematic Illustration of Formal and Informal Interactions in Contested Arenas
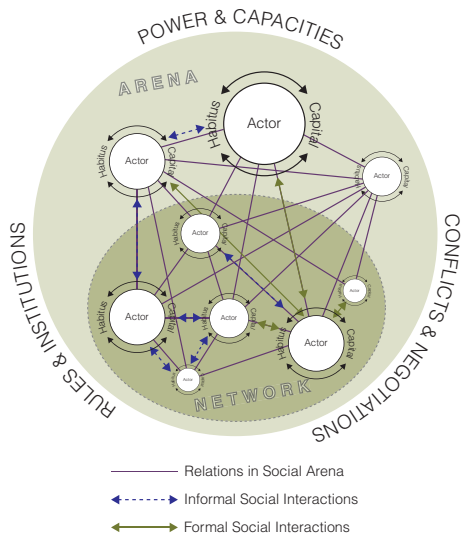
Source: Etzold et al., 2009, pg. 6. Draft: Etzold & Keck 07/08 Based on Sakdapolrak 07/06

Specific modes of governance in Dhaka's food system, and in the megacity as such, go hand in hand with distinct spatial practices of actors. Henri Lefebvre (1991, pg. 31) claims: "(E)very society [...] produces a space, its own space." If we see informality as the hegemonic mode of urban governance (Etzold et al., 2009, pg. 10) or the major "organizing urban logic" (AlSayyad & Roy, 2004, pg. 5), then informal interactions create their "own space". Space[3] is produced first and foremost through the contestations between hegemonic actors (i.e. state/city authorities, political leaders, etc.) and subaltern actors (i.e. marginalized citizens, street vendors, etc.), the play of institutions, and in particular, through the perception of space (Lefebvre, 1991; Werlen, 1997). For instance, the encounters that hawkers have had with state authorities not only shapes the way in which they are "seeing the state" (Corbridge et al., 2005) and formal institutions, but also how they are conceiving public space and thus, how they are exercising their "right to the city" (Mitchell, 2003). So even though state or city authorities might wield power over "their" citizens and formally regulate the city territory, they can hardly control (all) the social, cultural, political and economic (inter)actions and imaginations of the city dwellers. This inherent agency of actors, though often limited, can lead to everyday spatial practices in resistance to the formal institutions set by the state, an effect that Bayat (1997, pg. 6) has coined the "quiet encroachment of the ordinary". The following case study reveals daily negotiating processes of obtaining access to and using urban space from the perspective of street food vendors.

Street Food Vendors and the "Quiet Encroachment of the Ordinary"

In Dhaka, just like in Hyderabad (Dittrich, 2008), Bogota (Donovan, 2008), Mexico City (Wildner, 2009) or Lagos (Basinski, 2009), the sale of food along streets and in public places is, at present, a highly contentious issue. While street food vending is a good self-employment opportunity for the urban poor and an important functional element in urban food systems in countries of the Global South (Tinker, 1997), it is seen as obsolete, unhygienic, disorderly and "in the way" by city authorities and planners. Nevertheless, everyday vendors claim the streets, consciously ignoring formal rules (Bayat, 1997, pg. 133; Etzold et al., 2009, pg. 16).

Street food vendors apply different spatial practices according to the types of food they sell, their social and economic

[3]See Lefebvre (1991, pg. 33), Soja (2003, pg. 274) and Harvey (2006) for further elaborations of the trialectics of space.

capital, their perception of space, and their perception and understanding of the operating rules at their particular vending site. Consequently, there is a great range of vending styles that can be subsumed in four broad categories. Permanent shops have been solidly built, usually illegally, often located in small niches right next to a footpath. Semi-permanent vending units are larger tables that are set up for the day at the side of a footpath, but can be dismantled quickly and are usually removed at night. Semi-mobile vending units, such as push-carts or rickshaws, can be moved to reach consumers at different places at different times; however, they more often remain at one site for the whole day. Lastly, mobile vendors sell their products by walking around with a tray or basket of fruits, snacks or a flask of tea; they squat on footpaths and occupy parts of roads spread out over public places.

These vending styles can be considered different expressions of the production of space. As "the issue of space is simultaneously an issue of order and ultimately an exertion of power", (Bayat, 1997, pg. 145) state actors are compelled to react. The mobile vendors do not threaten the state's monopoly in regulating public space; therefore, they are largely tolerated. In contrast, the more permanent vendors not only challenge the state's authority through their appropriation of space, but they also question the state's formal institutions by making their own operating rules for their respective vending sites. Semi-mobile, semi-permanent and permanent vendors are, thus, the major targets of evictions. These (often violent) "clean-up-drives" are at present, more frequently carried out by the police in order to improve "public security" and "food safety" in Bangladesh, and thereby demonstrate state authority (Etzold, 2009). In turn, the vendors have to adapt to the erratic state's efforts to re-claim the streets, so as to reduce business loss and secure their livelihoods in the longer run. While the mobile and most semi-mobile food hawkers simply move their vending units quickly when they perceive a threat, the more permanent vendors hide their food and vending equipment near their vending site. However, many vendors wait-and-see and then draw on their social capital to reduce their loss, bridge income shortages and reclaim "their" vending site, for instance by bribing the police or seeking help from local power brokers (mastaans). Knowing "the right people" is, therefore, not only the key to getting access to a specific vending site, but this also determines the vendor's use of space and the extent to which the vendors can participate and shape the "politics of the street" (Bayat, 1997).

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Mobile vendors continue their business while more permanent vendors have left, as policemen control their vending site in front of the University Hospital in Dhaka

Conclusion

This case study analysis of the spatial practices of street food vendors offers insight into how the use of public space is regulated in Dhaka.[4] The mobility of vendors (as shown in Figure 3 in Etzold et al., 2009, pg. 17) can be explained inter alia by the shifting rigor with which formal rules are implemented. If there is no strong (state) actor present at the vending site to implement and sanction the formal rules, then informal arrangements that contradict the formal institutions come in effect through self-organization. This has concrete spatial implications as the vendors align their spatial practises only to those rules that they (temporarily) accept.

Megacities can be regarded as "global areas of risk" (Kraas, 2003) and insecurity, but they can also be looked at as "laboratories of the future" (Kraas, 2007, pg. 80) in which solutions to some of the key challenges of the 21st century (for instance adaptation to global environmental change) can be designed, tested and implemented. In order to do so, it is necessary to understand the inherent dynamics of the self-governance structures in cities in general, and in megaurban food systems in particular. Studying the sets of institutions that govern the everyday social and spatial practices of urban citizens is, therefore, of paramount importance, since it often thwarts utopian urban development plans. Despite the role we believe the state and formal institutions should have in (urban) governance, we must come to terms with the fact that the "revolution of space" (Lefebvre 1991, pg. 419), a counter-culture against state power and the state's appropriation of space, is not the dream or nightmare of the future. It is reality in present-day cities worldwide, a fact that is both irritating and encouraging.

[4]Another case study of this project analyzes the spatial practices of food wholesalers, and thereby offers insights into the limitations of urban governance (Etzold et al. 2009; Keck et al. 2009; Keck 2009; Keck, Staffeld 2009).

Melbourne, Australia

Urban Governance and Modern Challenges: Evaluating Urban Water Services

Sara Hughes

Urban growth has intensified problems related to water and energy use, air quality, and land needed to support the activities of cities and to assimilate their wastes, leading to global environmental change (UNEP, 2002). Many cities face difficulties meeting their water needs or disposing of their waste using resources within their immediate resource base and therefore, must increasingly rely on distant watersheds and aquifers (Vorosmarty et al., 2000; McGranahan & Satterthwaite, 2003). Although the impacts of these practices are becoming evident, adapting the resource use patterns of cities to changing social and ecological conditions is a politically contentious process, particularly for water. In addition, the social, political, and economic context within which adaptation to these changes will occur is much different from the time when most urban governance systems were put in place. Cities must innovate if they are to maintain or expand water provision capabilities in a sustainable way (Gleick, 2003).

Governance systems must be able to accommodate change and adapt quickly to changing environments. However, cities everywhere face the challenge of adapting water management strategies within governance systems that lack the flexibility needed for innovative change (Folke, 2003).

One entry point from which to understand and evaluate adaptation in a comparative urban governance context is to examine the role institutional features play in shaping policy outcomes. At the city level, institutional features such as the type of government, utility provider, and election rules have been shown to influence decision making in urban policy areas such as solid waste recycling, urban redevelopment programs, and water pricing. Strong executives can drive policy agendas and avoid gridlock and debate, providing momentum to selected causes and not to others. The type of utility – whether a specialized entity, privatized provider, or embedded within general government – can significantly influence the incentives, resources, and planning horizon of decision makers. Election rules for city officials such as councils, mayors, and board members can radically shift constituencies of elected officials and their accessibility for specialized interest groups. The degree to which these institutional features are fragmented among

a metropolitan area has been shown to shape not only policy outcomes, but the form of cities themselves (Lewis, 1996). Inconsistent and conflicting authority inhibits coordination and fosters localized, myopic decision making.

However, the influence of institutions on urban policy outcomes goes well beyond the formal structures of urban government. New developments in urban political economy can also drive policy outcomes. For example, the growing influence of the private sector in both urban and water policy can introduce new options for urban water services. Technological advancements such as water recycling, desalination, and reverse osmosis and nano-scale water membranes are often driven by private sector investment and research. Australia has several mechanisms for water businesses to access foreign markets and clients, with a strategy of marketing the "Water Brand Australia". With the emergence of "global" cities comes differentiated urban policy, increasing strategic action at the national level, and more direct network links between cities and the international arena. Combined with the growing authority of environmental concerns in many places, these features of urban governance create new and differentiated institutional effects on policy outcomes.

Water Recycling: A Window into Institutional Effects

This article presents preliminary research findings on how and when institutional features of urban governance affect urban water management outcomes. Here, water recycling in California and Australia is used as an example of adaptation in urban water management. Water recycling – also referred to as water reclamation and water reuse – is "the treating and managing of municipal, industrial, or agricultural wastewater to produce water that can be productively reused" (California Department of Water Resources, 2004). The existing and planned use of recycled water in urban areas is quickly accelerating. Governments, utilities, communities, businesses, and non-governmental organizations (NGOs) around the world have begun to weigh in on the advantages, disadvantages, and future role of this relatively new and sometimes controversial innovation in urban water management. Furthermore, water recycling requires deliberate investment in new technology and infrastructure through the coordination of multiple aspects of urban water management (e.g., wastewater, water supply, land use, infrastructure investment, and public perception), making it both a salient and analytically useful case to examine the influence of institutions.

California and Australia have been leaders in the area of water recycling, but have had different challenges and

successes (Table 1). Both places are well-developed, urbanized, democratic political units in the midst of drought; both also have highly populated arid areas and less populated wet areas; in both places decision making authority for water management lies at lower levels; and both places have fairly dichotomous urban and agricultural development. In California, authority is located with local water suppliers and in Australia, authority over water resources is constitutionally vested in states and often exercised by state-owned water companies. They are two of four governments worldwide that have regulations for water recycling, and they have developed recycled water for a variety of purposes (Angelakis et al., 2003). In both cases, their central governments have made water recycling a priority for the future sustainability of their respective regions.

Despite these similarities, Australia has been more successful than California in developing recycled water for household use in urban areas. Cities in Australia have begun to incorporate recycled water into residential water supplies: water suppliers provided 1.8 gigaliters of recycled water to households in 2005, and 16% of Australian households recycle water (NWC, 2008). California has not done so, despite greater investment and capacity for water recycling and a strong focus on urban water supplies presented in its most recent water plan. A significant advantage for Australia in terms of incorporating recycled water into residential supplies may be its institutional characteristics.

Variations in institutional features may be responsible then for these different successes. Water supply and sanitation in Australia are managed jointly through coordinated agencies, and the country has forged a number of intergovernmental agreements to coordinate the actions of the states with the goals of the federal government. The water business sector in Australia is also highly organized and is generating more affordable recycling options and developing better networks with urban water managers. In California there are separate agencies responsible for each part of the urban water system and coordination between the state government and local water suppliers are weak. Australia's highly coordinated system may reduce transaction costs in decision making, but may also limit the number of access points for public input.

Intergovernmental coordinating mechanisms are also stronger in Australia, further reducing institutional complexity and associated transaction costs. In Australia, each state has signed on to the National Water Initiative (NWI) of 2004. This is Australia's "blueprint for water reform", and outlines priorities, targets, and actions for water management authorities throughout the country (NWC, 2008). Thus, while the Commonwealth government does not have constitutional

Table 1 | Comparison of Geographic and Political Factors Behind Water Recycling in California and Australia

	CALIFORNIA	AUSTRALIA
POPULATION	36.5 million people 95% in cities 2/3 in southern arid region	21.7 million people 88% in cities 2/3 in 5 large, coastal cities
WATER SYSTEM	Highly managed infrastructure network Increasing restrictions on diversions Current drought emergency	Highly managed infrastructure network Increasing restrictions on diversions Current drought emergency
PER CAPITA URBAN WATER USE	878 liters per person per day	320 liters per person per day
MOTIVATIONS TO RECYCLE WATER	Provide reliable water supplies to mitigate risks from drought and climate change Meet environmental targets Reduce need for imported water supplies	Provide reliable water supplies to mitigate risks from drought and climate change Meet environmental targets Improve efficiency
CURRENT LEVEL OF WATER RECYCLING	647 GL /year 10% in planned projects 234 suppliers to 4,800 sites	425 GL/year 19.4% of effluent Over 500 sewage treatment plants recycle
RECYCLED WATER FOR INDOOR RESIDENTIAL USE	0	1.8 GL/year used in households 16% of households receiving
RECYCLED WATER FOR INDIRECT AND OUTDOOR DIRECT USE	78 GL/year groundwater recharge 130 GL/year landscape irrigation	38.5 GL/year by water supply and sewerage services
RECYCLING TARGET	1233 GL /year by 2010	Intergovernmental agreement to encourage recycling Individual city targets range from 10%-33% recycling of effluent Sydney: 70 GL/year by 2015 Victoria: 20% by 2010
PROJECTED INVESTMENT	$11 billion (USD)	$1 billion allocated by NWI (AUD)
WATER AND WASTE-WATER MANAGEMENT AUTHORITY	Separate	Joint
INTER-GOVERNMENTAL COORDINATING MECHANISMS	Weak Based on voluntary measures and financial incentives	Strong Shared goals and targets with formal agreements

Los Angeles, California

authority to dictate what these priorities, targets and actions will be, they have been able to successfully establish these jointly with state governments. The effects are felt throughout state agencies, academia, and local organizations in part through the large sums of money mobilized by the NWI, but also because states have internalized the standards into their own policies and practices. In California coordinating mechanisms have not been as successful in terms of establishing a shared vision for water reform. Two prominent examples of this are the State Water Plan and the Best Management Practices developed by the California Urban Water Conservation Council. While establishing priorities, targets and actions that water agencies should take to improve economic and environmental outcomes, the coordinating effects have not been significant. There are fewer economic incentives and less buy-in from water and wastewater agencies.

Countries around the world are looking to expand their water recycling capabilities. The complexity of water institutions and the incentives they generate will help determine the path these projects take and whether cities will ultimately face less risk in the future. Coordinating levels of decision making through water supply and wastewater management will be an important first step in many places. This could take place through consultative bodies, joint agreements, or full institutional

reform. An emphasis on local resources meeting local needs will help to incentivize water reuse and capitalize on place-specific expertise, and allow for a democratic decision making process. However, water management in many places is highly decentralized, which can present challenges due to the wide range of local level capacity (Dinar et al., 2005). Therefore, it is critical that institutions are able to both counter fragmentation and capitalize on site-specific expertise by reducing transaction costs, fostering shared ideas and norms, and encouraging experimentation.

As cities face the challenges of the coming decades, sustainable urban water management will become a necessary part of planning and policy. Urban governance institutions will help shape our response to these challenges, but should be understood in the context of broader developments and relationships. Water recycling is one example among many of the kinds of water management options cities are grappling with to adapt to changing demographic and climatic conditions. Identifying key institutional features that can be adapted or reformed is an important step toward meeting urban water challenges. Further research into the role of institutions will help illuminate not only why we observe the outcomes we do in different cities around the world, but also the mechanisms through which these outcomes may be influenced to enhance sustainability.

The references for this article are available on our website: http://ugec.org/docs/ViewpointsIssue2References.pdf

Arizona urban landscape

Landscape Fragmentation under Rapid Urbanization

Abigail M. York, Sainan Zhang, Christopher G. Boone, Milan Shrestha

In 1970, the United States became a suburban nation. The US Census Bureau recorded that in this year, more people lived in suburbs than in central cities. While some growth on the periphery is contiguous, "leap-frog" developments, edge cities, and exurban enclaves have created discontinuous patterns of settlement across the American landscape. Growth on the periphery has been made possible by a number of factors, from federally-insured mortgages to transportation technologies and investments, but little attention has focused on the role of ecosystem services in defining the characteristics of such growth. Over the next year, we will use a cross-site study to understand how the degree of land fragmentation varies with the magnitude and rate of change of water provisioning, population growth, and urbanization. In this article, we present our agenda for research using a socio-ecological system approach and present preliminary results from our pilot study of landscape fragmentation in Phoenix, Arizona.

We focus on landscape fragmentation because it affects biodiversity and ecosystem processes as portions of the landscape become isolated without connecting corridors. These changes decrease the ability of species to recover from disturbances (e.g. MacArthur & Wilson, 1967; Marzluff & Ewing, 2001; O'Neill & Hunsaker, 1997) and reduce connectivity that can promote ecosystem processes (Peters et al., 2008; Grimm et al., 2008b). Likewise, landscape fragmentation has important social implications, such as increased costs for public service provision (Camagni et al., 2002), decreased ability to use lands for agricultural (Carjens & van der Knaap, 2002) or forest production (Rickenbach & Gobster, 2003; Kline et al., 2004;

Alig et al., 2002), and loss of culturally relevant openspaces and natural amenities (Deller et al., 2001; Rickenbach & Gobster, 2003). The development of greenfield sites and the conversion of farmland and wildlands to subdivisions while central city lots and brownfields lie vacant, underscores the inefficiencies that accompany such growth (Boone & Modarres, 2006). Conflict on the urban-rural fringe between farmers, ranchers, and residents can lead to further fragmentation (Bunce, 1994).
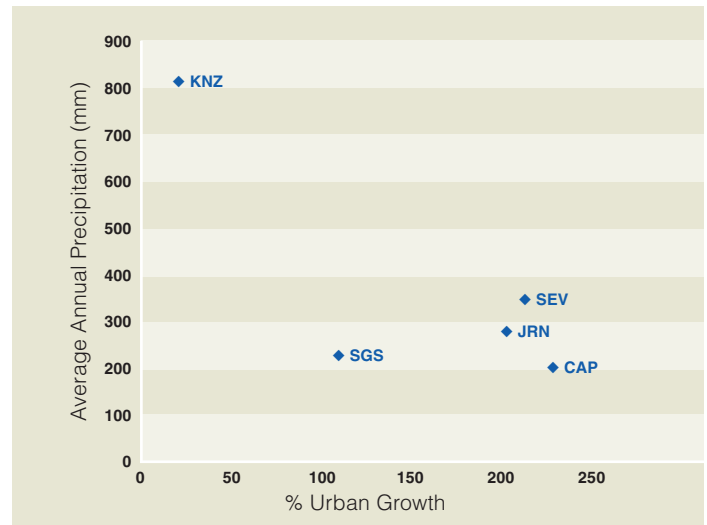
Landscape fragmentation may include fragmented land cover and/or land use, while fragmented land ownership is typically conceptualized as a driver of increased land cover/use fragmentation (Mitchell et al., 2002; Gosnell et al., 2006;

Stanfield et al., 2002). Some types of land cover may be more affected by land-ownership fragmentation than others; in a study of Colorado ranch-subdivision ownership, fragmentation caused more significant impacts on grasslands than forests (Mitchell et al., 2002). Fragmentation of land cover, use, and ownership all have potentially significant effects on and feedbacks within the social-ecological system (Redman et al., 2004; Grimm et al., 2008a). In an effort to outline new directions for research, the US Long Term Ecological Research community developed a novel conceptual framework that links social and ecological dynamics (Figure 1) (Collins et al., 2007). Ecosystem services provide the critical linkage between biotic structure and function and human outcomes and behavior. This proposal intends to examine some components of that framework by analyzing how ecosystem services bear on social systems to generate land fragmentation. Findings from this research will provide the foundational knowledge for "closing the loop" between social and ecological systems, specifically to examine how the fragmentation of land impacts biotic structure and function and, in turn, the ecosystem service of water provisioning.

Water provisioning is a critical ecosystem service in all cities, but it is especially relevant in arid ecosystems where it is difficult or costly to access the ground or surface water. To understand the relative strength of several proximate causes of landscape fragmentation, we employ a Long Term Ecological Research cross-site analysis along water, population, and urbanization gradients (Figure 2). Our study brings together social scientists

Figure 2 l Average Annual Precipitation (92-06) and Percent Urban Population Growth (70-00) for Case LTER Sites.

Figure 1 l Socio-ecological Framework from US Long Term Ecological Research Decadal Plan (http://www.lternet.edu/decadalplan/)
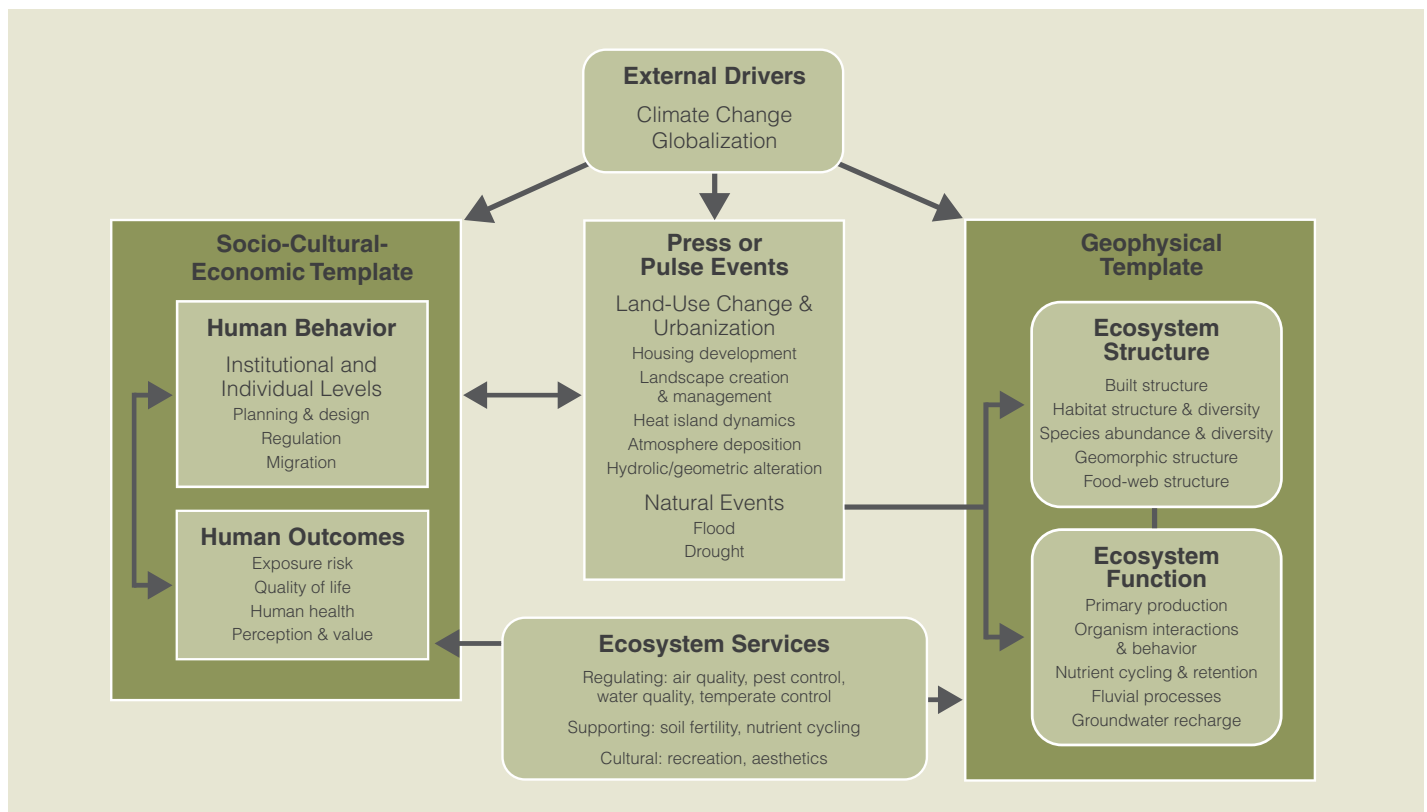
at five LTER sites with herbaceous cover where landscape fragmentation is ongoing, yet occurring at different rates and with varying patterns: Phoenix (Central-Arizona), Konza Prairie (Kansas), Jornada Basin (New Mexico), Sevilleta (New Mexico), and Shortgrass Steppe (Colorado). The ecosystems at these five sites are all strongly regulated by variations in water resource availability, with four being semi-arid to arid. The cross-site study will test the following hypotheses:

H$_0$: Sites with higher water provisioning will have greater fragmentation of land cover, use, and ownership.

One of the primary linkages between humans and ecosystems are the ecosystem services that are provided (Daily, 1997; Collins et al., 2007); freshwater provisioning (quality and quantity) is perhaps the most important service provided by ecosystems and greatly shapes a landscape's carrying capacity for humans. We hypothesize that water provisioning will partially explain the amount and pattern of land fragmentation within the western grasslands context, with more water associated with greater fragmentation. Water provisioning will include precipitation, surface and groundwater (minus evapotranspiration) (Fekete & Vorosmarty, 2000), and water delivered by engineered infrastructure (minus measured water loss, typically 20-30%, in the system). The analysis of water provisioning will include an assessment of water supply and demand, but will extend the analysis to include an assessment of water rights as a limiting factor.

H$_1$: Sites with greater human populations and growth rates will have greater fragmentation of land cover, use, and ownership.

Larger populations will increase competition for land, decreasing parcel size and increasing fragmentation. Those sites facing greater growth rates, in absolute and in proportional terms, will also have greater fragmentation due to the increased demand for lands, and the inability to respond quickly with comprehensive planning and controls.

H$_2$: Sites with larger urban population and higher rates of urbanization will have higher fragmentation of land cover, use, and ownership.

Dense settlement and intense competition for land in urban areas will amplify the relationship described in H$_1$. An "urban effect" on land dynamics within and beyond urban areas will be a major driver of fragmentation. Higher magnitudes and rates of urbanization will lead to greater fragmentation throughout the study extents.

To begin to understand fragmentation patterns for each site, we first assess the underlying changes in fragmentation from 1992 to 2001 using data from the National Land Cover Dataset (NLCD) for the years 1992 and 2001 compiled from Landsat satellite TM. We quantify fragmentation pattern with six landscape metrics for twelve individual cities and then examine the fragmentation level of each pixel within the whole research area using a moving window. We present the preliminary results for changes in temporal and spatial fragmentation patterns for Metropolitan Phoenix, our pilot site. Jurisdiction level data allows us to unpack underlying institutions that affect land-use decision-making and resulting landscape fragmentation. The twelve city analysis illustrates that fragmentation is not only related to urbanization, but is also associated with municipal jurisdiction, which may reflect the impact of land use institutions on development patterns.

The statistical accuracy of the 1992 data known for the region is around 70% to 75%. We reclassified the original land use/cover classes into three categories: Undeveloped, Developed, and Cultivated. Using Fragstats, we quantified the fragmentation pattern through landscape metrics, including Number of Patches (NP), Largest Patch Index (LPI), Contrast-Weighted Edge Density (CWED), Interspersion & Juxtaposition Index (IJI), Contagion (CONTAG) and Shannon's Diversity Index (SHDI). We calculated these metrics for individual cities and then examined the fragmentation level of each pixel within the whole research area using a moving window. Then, we analyzed the temporal, spatial fragmentation pattern for Metropolitan Phoenix.

Our research results indicate that rapid urbanization has resulted in increased fragmentation in peri-urban areas. Over the period of study, fragmentation near the urban core decreased via infill processes while greater fragmentation has occurred as growth has moved to the northeast valley (Figure 3). Our twelve city analysis indicates that fragmentation is not only related to urbanization, increased change to the developed classification, but is also associated with jurisdiction, which may reflect the impact of land use institutions on development patterns and water extension decisions. For example, communities within the Phoenix metropolitan area such as Fountain Hills, Chandler,
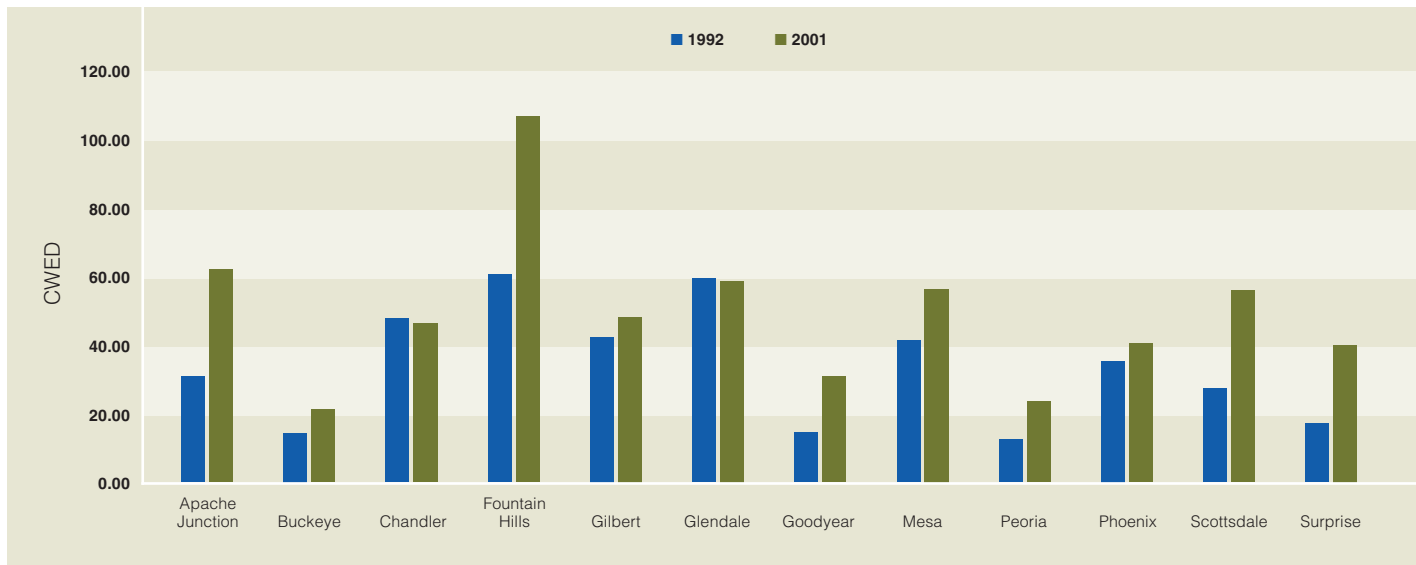
Phoenix city scape

Figure 3 I Fragmentation Patterns: Moving Window Analysis of Number of Patches (NP) and NP by Jurisdiction

NP, 1992

HIGH: 29
LOW: 1

NP by Jurisdiction, 1992

HIGH: 4.91
LOW: 1.67

NP, 2001

HIGH: 26
LOW: 1

NP by Jurisdiction, 2001

HIGH: 5.66
LOW: 1.87

Figure 4 I Contrast-Weighted Edge Density (CWED) of Each Individual City (1992-2001)
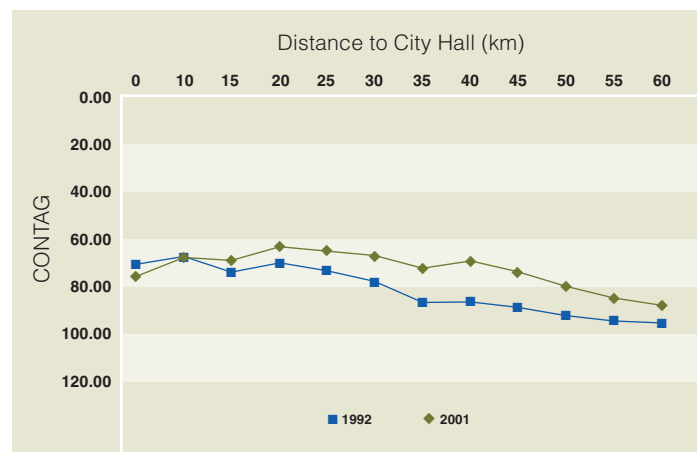

and Glendale experienced the highest conversion of non-developed land to developed and cultivated land during 1992 to 2001. However, Fountain Hills, Apache Junction and Scottsdale are the cities which experienced the most fragmentation change; while in contrast, fragmentation decreased in Chandler and Glendale (Figure 4).

In order to understand fragmentation as a function of distance to the central city, we used a 270m by 270m square moving window to examine the fragmentation spatial distribution, and analyzed the gradient through 12 buffer rings within 60 kms from Phoenix City Hall. Additionally, we used ArcGIS to conduct a fragmentation gradient analysis for sixty kilometers from the Phoenix urban center to present the spatial distribution of fragmentation. The main finding from this analysis is that the highest-level of fragmentation has spread out ten km from the urban center during the last decade, and that suburban areas at forty km from the urban center are experiencing the fastest rates of fragmentation (Figure 5).

Our research results illustrate that rapid urbanization has resulted in increased fragmentation in peri-urban areas. The moving window and jurisdiction-level measures indicate that fragmentation is not simply a function of distance to urban center or land cover change, but also a result of institutions and path dependence. We are replicating this preliminary assessment for the four other sites: Albuquerque, NM; Fort Collins, CO; Las Cruces, NM; and Manhattan, KS. Upon completion, we will begin to test our hypotheses about water provisioning, growth, and population. Water provisioning is a critical link in

the socio-ecological system that is governed both by humans through institutional decision-making and by the ecosystem itself. We believe the LTER conceptual framework provides a useful intellectual foundation for urbanization research in the context of global change.

Figure 5 I Contagion (CONTAG) at Differing Distance from Urban Center (PHX City Hall) (1992 and 2001)

The references for this article are available on our website: http://ugec.org/docs/ViewpointsIssue2References.pdf

Porto Velho, the capital of the Brazilian state of Rondônia in the upper Amazon River basin

Hierarchy of Urban Areas in the Brazilian Amazon and Its Environmental Implications

Gilvan Guedes, Sandra Costa, Eduardo Brondízio

The Legal Brazilian Amazon shares the reputation of being the largest rainforest in the world and an area of exponential urban development. Yet, population-environment research in the Amazon has focused mainly on rural areas, despite the increasing prominence of cities in the region. There is a growing, but still limited, literature discussing and proposing analytical models of urbanization dynamics in the Amazon, their spatial-temporal distribution and relation to road-river networks, and their social and economic interconnections and consequences (e.g., Becker, 1985; Machado, 1989; Browder &Godfrey, 1997; Perz, 2000; Browder, 2002; Padoch et al., 2008). This report summarizes the analytical approach and results within a forthcoming article (in *Population & Environment*) in which we contribute to this emerging literature by examining the level of primacy among Amazonian cities, their relative importance and infrastructural differences, and their level of interdependency

resulting from inter-urban demographic movements. We test the proposition by Browder and Godfrey's *Rainforest Cities* (1997) of the inexistence of a regional urban hierarchy ("disarticulated urbanization") and use the methodological approach presented by Garcia and colleagues (2007) to analyze it.

Our model uses a combination of nationally representative surveys and community-level data, which allows us to test a classical articulated urban model (e.g., Christaller, 1966) at three different spatial levels: regional, sub-regional, and local. Our analysis of regional urban articulation complements other efforts that have called attention to intra-regional differences (e.g., Perz,

2000) and attempted to stratify and qualify sub-regional urban networks using similar methodology as presented here (e.g., Garcia et al., 2007; IPEA, 2002). Our analysis also aims to support current efforts to develop regional and state level Ecological-Economic Zoning (ZEE) and to inform predictive models of deforestation and expansion of human occupation in different parts of the region. Attention to the formation of urban networks, their axis of expansion and their intersection with a growing but largely disconnected system of protected areas is necessary to understand the future of population distribution, the surrounding human landscapes around protected areas, gradients

Urban development in Macapa, the capitol of Amapa on the Amazon River in Brazil

of land and resource rent value, pollution sources and sinks, the formation of market chains, and regional variations in patterns of economic development.

We used several data sources to study and analyze urban growth, development, and hierarchy at three different spatial levels of the Legal Brazilian Amazon (LBA) – regional, sub-regional and local. Our analytical sample includes 747 observations at the level of municipalities, derived from micro level data collected by the Brazilian Demographic Census (IBGE 1991, 2000). We also used databases from the Brazilian National Council of Municipalities (CNM, 2007), the Brazilian Hospital Information System (MS, 1998 & 2002), the Brazilian Population Tally (IBGE, 2007) and the Brazilian National Archive of Health Establishments (MS, 2002) for analysis of the regional and sub-regional urban levels. For the local level, we used ethnographic field data, community surveys, and archival research collected by members of the Anthropological Center for Training and Research on Environmental Global Change (ACT) at Indiana University of 181 communities located in the municipalities of Santarém, Belterra, and Monte Alegre. Our community sample, surveyed in 2004, ranges, in terms of population size, from 10 to over 5,000 individuals.

The Grade of Membership Model

The Grade of Membership (GoM) model, a statistical methodology, was used to delineate clusters of elements within a heterogeneous dataset (Manton et al., 1994). The GoM model is classified as a fuzzy cluster technique because the same individual is allowed to have a certain level of pertinence to multiple sets. In the GoM method, an estimate of the degree of pertinence for each individual relative to all the sets is created, resulting in a fuzzy set or partition for each individual. For each element in a fuzzy set, there is a score of the degree of pertinence, g_{ik}, which represents the degree to which that element i belongs to the reference group, k. The value g_{ik} represents the intensity of pertinence to each of the extreme profiles. The number of extreme profiles

can be established according to two criteria: by means of a theoretical orientation, or by using the Akaike Information Criterion (AIC) as the test statistics for comparison of a model with $k+1$ and a model with k profiles (see Manton et al., 1994). In our analysis, we based our criterion on the three hierarchical regional levels proposed by Garcia and colleagues (2007) and Browder and Godfrey (1997) and applied random selection of the first three elements of the sample defining the extreme profiles. Technical details, including the algorithms used to delineate the mixed profiles, are available in a forthcoming article (Guedes, Costa & Brondízio, n.d.).

Urban Hierarchies

Based on the profiles from the GoM model, we classified the Amazonian cities into seven different levels of urban hierarchy (Figure 1): a) regional first level (Belém, Manaus, Cuiabá, Porto Velho, Macapá and Boa Vista); b) regional second level (São Luís, Rio Branco and Palmas); c) sub-regional first level (the cities of Imperatriz, Araguaína, Ji-Paraná, Marabá, Santarém, Altamira and Rondonópolis, plus 68 other cities); d) sub-regional second level (211 cities); e) local first level (224 cities); f) local second level (56 cities), and g) local third level (173 cities).

At the regional level, the disarticulated nature of urbanization in the Legal Brazilian Amazon suggested by Browder and Godfrey (1997) can be visualized in Figure 1. Some small urban areas of limited importance offer the only urban alternative for some populations in hundreds of square kilometers. Similarly, important sub-regional cities are "disconnected" from regional urban centers, creating a pattern that does not correspond to Christaller's theory (1966). This disarticulation also creates unexpected linkages within and between cities and between different states, calling attention to the limits of using municipal area boundaries as units of analysis.

At the sub-regional level, our results suggest a more traditional hierarchy. Node cities, as called by Costa and Brondízio (n.d.), appear in our model as a reference for a set of small surrounding cities. They function as central places providing services and attracting temporary workers and students who reside in different municipalities. They also have an important position as receptors of migrants coming from the surrounding areas. The relative isolation of some small cities to larger urban centers reinforces their dependence on these sub-regional node cities, as they represent within the Amazonian region, the only connection to an urban reality for rural residents and those living in impoverished villages and towns.

No clear hierarchical pattern, on the other hand, seems to emerge at the local level (Figure 2), as there are similar numbers of

Figure 1 I Urban Hierarchy Based on the GoM Profiles for the Legal Brazilian Amazon
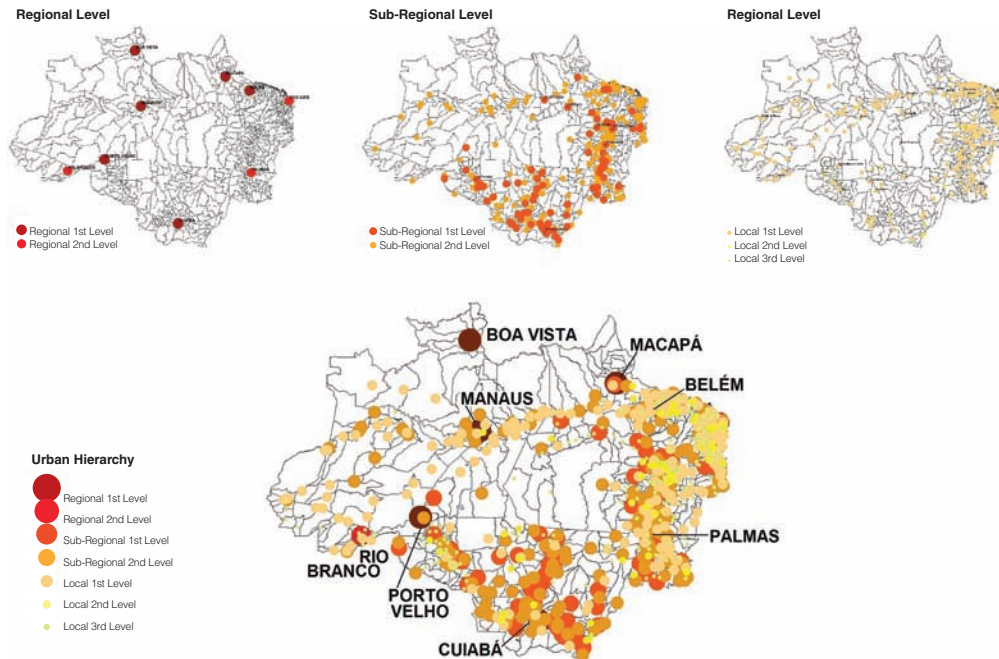

communities within each hierarchical category. This is not totally surprising given that many communities receive similar levels of support from municipalities and can access services in urban centers. There are, however, large and important communities located away or in-between regional urban centers, which provide important services to other surrounding communities and farms. In a region where distances and travel conditions are significant constraints, communities in-between urban centers assume a micro-hierarchical position in the provisioning of services and social activities.

Implications for Urban Development and the Environment

This unique nature of urban hierarchies in the Brazilian Amazon, with a disarticulated urbanization at the regional level but with more traditional hierarchies at the sub-regional levels, has important environmental implications. Along with the exponential growth of urban areas since the late 1980s, the region has seen a similar growth of both reserves and conservation areas and agro-pastoral activities. The confluence of these systems, their spatial overlaps and adjacencies, and their respective institutional arrangements are defining the future axis of occupation and connectivity within the region. The growing network of urban areas is contributing to a situation of high level connectivity between land use systems and social groups within and between ecosystems and watersheds (Brondizio, Ostrom, & Young, 2009) As a result, the region is starting to witness blocks of protected areas surrounded by urban and agrarian systems, thus creating "island conservation"

Figure 2 I Settlement Hierarchy at the Local Level
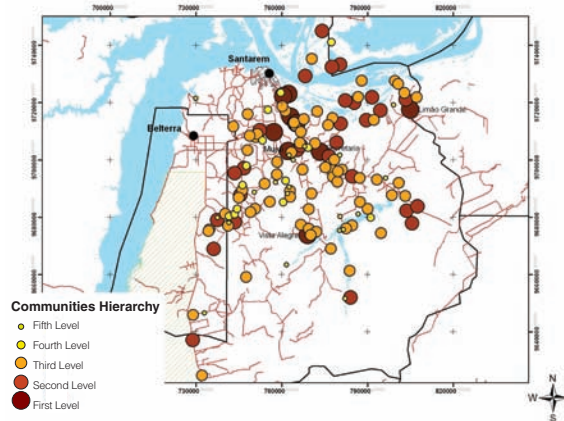
effects and fragmentation of habitats. The propagation of impacts within such situations also increases, particularly given the distribution and size of important watersheds in the region.

Intra-regional connectivity and urban network complexity create new challenges for conservation and regional planning. Projected scenarios of climate change in the region raise further concerns about the impact of urban network expansion in the region and vice-versa, the impact of climate change on urban populations. Understanding the forms and fronts of urban network expansion and their intersection with conservation areas and expanding land use systems is an important component of any program aimed at improving the quality of life for regional populations and finding sustainable solutions for reconciling conservation and development in the Amazon.

The references for this article are available on our website: http://ugec.org/docs/ViewpointsIssue2References.pdf

Street scene in Playa del Carmen, Mexico

Urban Transitions for Progressive Climate Proofing: Mexico's Caribbean Coast

Mark Pelling, David Manuel–Navarrete, Michael Redclift

The Mexican Caribbean is amongst the most rapidly urbanising and at-risk coastal regions worldwide. Rapid socio-ecological change is driven by international tourism, and provides a unique opportunity to study those processes that shape capacity to build mitigation and adaptation to global environmental change into development. Rapid social change policy for adaptation and mitigation (climate proofing) needs to be forward looking and include the assessment of underlying social capacities that can point to opportunities or constraints on future action. This commentary summarises theoretical and empirical work that seeks to test the utility of a resilience-transition framing for meeting this challenge by using social learning and self-organisation as indicators of capacity for future climate proofing. Empirical work in Mahahual and Playa del Carmen, Quintana Roo, Mexico is used to test the value of this approach for informing urban development policy. Findings highlight the role of culture and sense of place, and the political/administrative historical context in determining social capacity for progressive climate proofing from the viewpoint of civil society under rapid urbanization.[1]

Urbanisation, Resilience and Transition

Urban settlements are being recast as hotspots of risk (Pelling, 2003) with calls for urban development to be climate proofed in response to both adaptation and mitigation (McEvoy et al, 2006). This, in turn, requires that the capacities for transition to a climate proofed future are made clear. To date, the integration of climate proofing into urban policy has tended to focus on legislation and technical innovation for mitigation such as

transportation planning, architectural design, clean air and solid waste management that can help mitigate hazard (e.g., European Environment Agency, 2004). There has been much less attention on adaptation planning and the cultural, social, and political contexts that determine policy and action.

Resilience theory offers two useful mid-level theoretical tools for evaluating capacity for transition: social learning and self-organisation. Social learning (the possibility that individual

innovations can spread throughout social systems) and self-organisation (the possibility for spontaneous and unplanned collective action) are believed to be key attributes for social systems that can identify and respond to unexpected shocks such as those associated with global environmental change. Beyond this, the appropriateness of resilience is constrained by its emphasis on systems persistence (Folke, 2006). The core functions of dominant social systems, social control to enable

Mahahual after Dean

the conversion of labour and environmental assets into economic wealth, rarely serve the interests of the majority population or equitably meet those of minority groups (Gallopin, 2006) so that their persistence is not automatically a desirable attribute. Core functions are perhaps most contested in urban systems where freedom from direct dependence on ecological resources and the presence of social and cultural diversity mean there may be few shared core needs and values.

Taking social learning and self-organisation forward, work on transitions offers a meta-theoretical framing and one that points analysis at the interaction of ideas or collective action over scale as well as space and time. Transitions are processes of profound change affecting institutions, structures and actor behavior and values, so that a post-transition system operates according to new assumptions, rules and practices (Jerneck & Olsson, 2008). Geels (2002) argues that it is at the local level that symptoms of crisis are identified and may be responded to promoting transition; the regional level is resistant to change due to internal alliances and linkages; but, the national and global level can be a source of incremental transition through changing economic policy or environmental conditions.

Social Capacity for Progressive Climate Proofing on Mexico's Caribbean Coast

The Mexican Federal State has a good track record on climate proofing (as far as any national position can be so described)

including a National Strategy on Climate Change launched in 2007 and preparations for a Special Programme on Climate Change. Thanks to these efforts Mexico has jumped from 14th in 2006 to fourth in 2008 out of 56 countries ranked according to their climate change performance in the Germanwatch "Climate Change Performance Index" (Germanwatch, 2008). By contrast at the regional level, Quintana Roo has not integrated climate proofing into development policy, although it does take the associated domain of hurricane risk management seriously, and has a good record in containing human loss (Manuel-Navarrete et al., 2009). The most recent event, Hurricane Dean, in 2007, caused limited human impact.

Within this wider context, the data presented below allows a comparison of capacity for transition in two towns from the viewpoint of civil society. Mahahual is a pioneer settlement with a population of about 500 largely in-migrants from Mexico and internationally. The local economy boomed with the construction of a cruise ship terminal but has been in decline since this was closed as a result of Hurricane Dean. Playa del Carmen has a successful and growing economy based on international tourism and in 1994 became the capital of the newly created Municipality of Solidaridad. In 2005 its population exceeded the 100,000 inhabitants. Playa has experienced direct hits from hurricanes. The worst challenge came in 2005 with category 4 hurricanes Emily and Wilma; just a few months apart. However, there were no fatalities and the town recovered very rapidly. In fact, the local tourist economy benefited from the relocation of tourists from Cancun which had been hit even harder by Wilma.

We summarise local capacities for transition to a mode of development that can embrace progressive climate proofing in Table 1; we identify four key aspects of capacity derived from a synthesis of resilience and transitions theory: dominant worldviews, learning outcomes, constraints and opportunities for self-organisation.

Authorities visiting Mahahual after Dean

Table 1 I Capacity for Transition

	MAHAHUAL	PLAYA DEL CARMEN
DOMINANT WORLDVIEWS		
Dominant values	Individualism, place construction	Individualism, place alienation
Development narrative	Individual, economic advancement an 'open frontier'	Individual, economic advancement, 'the American Dream'
LEARNING OUTCOMES		
Constructing climate change	Abstract awareness is high, constructed locally as hurricane risk, part of the 'cost of living'	A strategic narrative for promoting existing social and environmental agendas (e.g., public health and solid waste management)
Mitigation	Future vision exists but little action	Awareness raising amongst family run hotels
Adaptation	Individualised (e.g., savings as insurance)	Lobbied for Sustainable Coastal Tourism plan
Information flows	Open but with limited local fixing	External information and expertise, key resources for local collective action
CONSTRAINTS ON SELF-ORGANISATION		
Culture	Competitive, lack of trust fuelled by weak formal institutions	Lack of individual self-worth and civic pride, no culture of volunteerism
Society	Diverse and atomised with many in-migrants and limited collective action.	Competition and lack of collaboration between civil society organisations
Economy	Distorted by land speculation and stalled post-Dean	State-corporate capital alliance marginalises and co-opts civil society action
Governance	Bureaucratic administration and few civic associations	Party competition undermines institutional learning and suppresses co-learning with civil society
OPPORTUNITIES FOR SELF-ORGANISATION		
Culture	Post-Dean, a common vision for the future has strengthened community identity	Work by local organisations to build self-worth and exercise political rights to challenge dominant development
Society	Post-Dean cohesion could build collective action	Recognising the shift from temporary to permanent residence could build community and pride in place
Economy	Post-Dean reconstruction opens scope for diversifying the economy and mainstreaming climate proofing	Resilient economy provides capacity for climate proofing and tourism's dependency on ecosystem services is a potential narrative for change making
Governance	New local government claims local responsiveness	Strong capacity for change if political will exists

The joint resilience-transition framework highlights the limits to bottom-up climate proofing within the contemporary development regime experienced in each study site. Importantly, state level institutions were critical in blocking incremental transition from the federal level and also in constraining local capacity for action. In both sites this was compounded by values oriented towards individualism, short-term economic profit motives and a lack of identity with place, which served to constrain discourses on climate change and development and visions of what might be possible for local social action. This combination of resistance in formal institutions at the state level and the abdication of individual responsibility for action justified through dominant local discourses of development is surely a considerable constraint on capacity for progressive climate proofing.

Social learning was inhibited in both Mahahual and Playa by a lack of access to scientific knowledge on climate change and climate proofing options. In our interactions with local agents, climate change was discussed but mostly indirectly, through local development challenges – beach erosion, loss of urban green space and solid waste management in Playa, and loss of mangroves following Hurricane Dean and post-Dean reconstruction in Mahahual. Responsibility for behavioural change to mainstream adaptation and mitigation was largely pushed onto the state or to an anonymous global community, reflecting strong centralisation in Mexico and Quintana Roo and the alienation of local actors from responsibility for climate change action. Dependency on paternalistic state structures was questioned in the face of state inaction on climate change. Yet, successful evacuation following Hurricane Dean was presented as proof of state competence. In this way demonstrable state capacity in disaster response was extended to equate with climate change, and allowed respondents to abdicate responsibility for climate proofing. Certainly, climate proofing had not become a rallying point for alternative visions of development. Scope for institutionalisation of mitigation outside of the state was identified in Playa through family run hotels with stakes in sustainable development, but overall respondents viewed the role of private sector activity as focused on fast economic gain with little concern for social development or climate proofing.

Social organisation in Mahahual was greatly undermined by a lack of trust in organised social action and in community leadership. Against this background, Hurricane Dean was cited as having catalysed collective action through installing a shared sense of place amongst residents who stayed behind after the hurricane to rebuild. Playa's small, professional but competitive

© David Manuel-Navarrete

Early warning banner in Mahahual

civil society undermined scope for coalition forming. Underlying this was a weak cultural base – individualism was the norm with little formal culture of volunteerism and a sense of place was limited. Even though many migrant residents had put down roots, they did not self-associate with Playa. Government was constrained by a highly competitive and dynamic political culture with politicians and officials coming in and out of office frequently and seldom building on past knowledge or initiatives. In both settlements, outside skills and information were successfully drawn on by civil society actors.

Conclusion

Given the constraints observed for both sites, any bottom-up civil society led capacity building process for progressive climate proofing in Quintana Roo is likely to be challenging. While innovation may arise from local actors, the scope for up-scaling or horizontal replication is limited by resistance at the state level and in common culture. Consequently, in the current context, change at the scale and pace required to meet the challenges of adapting and mitigating to climate change requires top-down, government led action. Action will need to engage with local actors for legitimacy and appropriateness, and collaborate with the corporate private sector, but nonetheless needs federal and state level government leadership. The need for concerted action across governance scales to reform the institutions of state government and challenge dominant culture is perhaps the most important outcome of the resilience-transition framework. This need is likely to be shared by those many societies that are exposed to climate change risks, but have not yet integrated climate proofing into development planning.

The references for this article are available on our website: http://ugec.org/docs/ViewpointsIssue2References.pdf

Abuja, Nigeria, Africa

Managing City Growth and Development in the Context of Environmental Changes within Sub-Saharan Africa

Shuaib Lwasa

Africa's urbanization rate has steadily increased over the past three decades and is now the fastest urbanizing region in the world (UN-Habitat, 2008, pg. 16). It is estimated that by 2030, over half of the African population will be living in urban areas. But just what is the nature and form of this increasing urbanization and how prepared are city authorities and governments for this process in view of environmental change, particularly the effects of climate change? Although evidence suggests that urbanization is progressing faster in countries where economic growth rates are also steadily increasing (Satterthwaite, 2005, pg. 2), as places of production, employment and innovation, cities and urban centers of sub-Saharan Africa experience an economic dualism of the formal and largely informal economy. The literature has, for the last three decades, described the urbanization process in Africa as "pseudo-urbanization", where cities form without the needed infrastructure to support them.

Although industrialization, the service sector, infrastructure, communication and trade have grown, rapid urbanization results in a disproportionate growth in population against the corresponding economic transformation. The consequences of such rapid urbanization are largely negative including the alarming increasing incidence of poverty, urban sprawl, inadequate social services and infrastructure deficiencies. The negative consequences have subsequently led to the deterioration of conditions in human settlements, pollution, and the depletion of natural resources.

Due to the pattern of urban growth and other factors, African countries have chronically faced the challenge of managing urban development and still grapple with mobilizing financial resources,

reforming urban governance, mobilizing communities, investing in urban infrastructure, sustaining the urban environment and providing social services; all of which would promote the necessary growth of urban economies sufficient for tackling urban poverty. Africa is projected to have the world's shortest urbanizing period and as it enters the urban "age" it will also be affected by global environmental change and most markedly, climate change (UN-Habitat, 2008, pg. 17). Africa is the most vulnerable to climate change because of its limited capacity for recovery and management of disasters (IPCC, 2001, pg. 8; Prasad, 2009, pg. 2). Africa is already experiencing extreme events in terms of climate variability and climate change impacts from droughts, flooding,

violent storms and sea level rise, all of which have put many cities at risk and made millions of Africans vulnerable. Thus, Africa faces two main challenges at present; first, is its speed of urbanization - high compared to other regions, but Africa lacks the needed corresponding speed of response for such a challenge. Second, the vulnerability of urban areas to climate change impacts.

Drivers of Urbanization and Development Challenges

Several drivers are responsible for urbanization including population dynamics, economic growth, legislative designation of new urban centers and increases in densities of rural trading centers. Notably, the megacities such as Lagos, Cairo and Kinshasha are expanding further (UN-Habitat, 2008, pg. 16). Although urbanization presents opportunities in sub-Saharan African countries, the challenges for urban development are overwhelming. These challenges include social service provision, sustainable economic development, housing delivery, urban governance, spatial development guidance and environmental management for disaster and risk reduction (Enyedi, 2003, pg.15). In addition, these challenges pose sustainability concerns in social, economic, environmental and institutional contexts, requiring well designed strategies to create positive impacts of urban development.

Sustainable urban development and management should be of high priority in sub-Saharan Africa. As observed by UN-Habitat, systemic policy failure has provided ground for the proliferation of informal cities (UN-Habitat, 2008, pg. 16). Since

urban development is crucial to social transformation as engines of growth, urban centers need to be managed properly in order to enhance and promote regional development. With the emergence of urban corridors across the region, there is hope that urban areas will play a significant role in unlocking rural lands and guiding population away from the primate cities.

Climate Change and Implications for Sustainable Development

As the process of urbanization accelerates in Africa, there is growth of an "emerging" economic sector that not only contributes to national economies but also provides employment and livelihood for many urban dwellers. However, this emerging sector together with other urban sectors, are facing the wrath of environmental change and particularly climate change. Climate change concerns are intensified by the alarming growth of the slum population across the region. As observed by UN-Habitat, slum population growth is averaging between 3-6% and in many countries it is higher or equal to urban population growth (see Table 1). This raises concerns for urban sustainable development in the context of environmental change.

Attention is increasingly focusing on the societal conflicts associated with environmental sustainability (Enyedi, 2003, pg. 15); conflicts that become more evident as urbanization levels increase while urban environment degradation accelerates (IHDP, 2005, pg. 45; IDRC, 2006, pg. 5). In the developing world, environmental considerations are continuously challenged because they have not been coupled with an efficient programme

Table 1 | Comparative Statistics of Access to Urban Services in Elected Sub-Saharan African Countries

	YEAR	TOTAL POPULATION (MILLIONS)	URBAN POPULATION (MILLIONS)	SLUM POPULATION (MILLIONS)	URBAN POPULATION GROWTH RATE (%)	SLUM POPULATION GROWTH RATE (%)	ACCESS TO SAFE WATER (%)	ACCESS TO IMPROVED SANITATION (%)
COUNTRY								
UGANDA	1990	17	2	2	5	5		
	2001	24	2.8	2	5	5	72	16
RWANDA	1990	7	0	0	3	4		
	2001	8	0	0	3	4	60	37
TANZANIA	1990	26	6	6	7	6		
	2001	36	12	11	7	6	80	18
KENYA	1990	24	6	4	6	6		
	2001	31	11	8	6	6	87	53
ZIMBABWE	1990	10	3	0	4	3		
	2001	13	5	0	4	3	100	96
DEMOCRATIC REPUBLIC OF CONGO	1990	37	10	5	4	4		
	2001	53	16	8	4	4	89	56

Source: UN Habitat, 2001 http://hq.unhabitat.org/list.asp?typeid=44&catid=240

of easing urban poverty. Improvements in the urban infrastructure, education and the health care service, housing, transportation and communication cannot be made without giving equal rights to the poor and the other disadvantaged social groups, and without recognizing their informal organizational capacities (UN-Habitat, 2004, pg. 1; Enyedi, 2003, pg. 62). No environmental policy can be efficient without a social policy. Capacities of communities to cope with environmental challenges with or without support from the city authorities have been described as informal forms of organization, for example, the self provisioning of infrastructure and services. Sustainable urban development can be looked at as encompassing six areas: (1) governance, (2) social and cultural considerations, (3) social infrastructure and public services, (4) urban land use and housing issues, (5) urban transport and urban natural resource management, and (6) employment and the enhancement of economic growth. These six areas form the framework for understanding the sustainability of urban development and also shed light on how to achieve sustainable urban development.

The Case of Uganda

City management in sub-Saharan Africa is characterized by a mix of policies and approaches including decentralization, centralization and autonomous authorities. Although an effective urbanization policy is one of the several instruments to guide development in many of these countries, there are disproportionate policy responses resulting in inconsistencies and unguaranteed orderly and sustainable urban development. For example in Uganda, the current Local Governments Act has succeeded in the devolution of power to local governments for effective planning and delivery of services to the urban populations. Although the Act was implemented in 1993 and is still possibly in its gestation period, analysis of its efficiency thus far has indicated shortcomings in the requirements for sustainable urban development. One lesson to take from Uganda is that challenges of urban development include the effective and efficient provision of urban services, governance, infrastructure development, climate change mitigation and adaptation. These are key aspects of urban development not only because of their influences on the economic, social development and environmental status of an urban area but they are also necessary due to increasing climate change vulnerability. Social and economic development needs a spatial framework but decentralization has led to competitive allocation of resources with little consideration of equitable spatial development of the city. One of the key consequences of this is marginalization of large sections of the urban population, leading to polarization.

Furthermore, there are many risks associated with environmental change in sub-Saharan Africa including: urban health, urban transportation, urban energy consumption, urban water and sanitation and urban waste management. For example, in Uganda energy demand stands at 0.00012 ton/vec.km for the public transport sector. And, while improved drinking water access only rose to 54% in 2006, with sanitation improving to 29% in the same year, garbage collection coverage in one of the municipal divisions increased from 10% to 80%, reducing the unit cost (in Uganda shillings) of collection from 11,300/m^3 to 4,500/m^3; or the equivalent of US\$8/m^3 to US\$3/m^3. With the level of energy use coupled with poor management of wastes, the burden is placed on the environment through GHG emissions. It is therefore necessary for urban sustainability to be placed high on the development agenda in sub-Saharan Africa. Other challenges that face these nations include the increasing social polarization of urban communities, environmental degradation, increasing burdens on large proportions of the urban populations (i.e., poor sanitation, flooding, wastes accumulation, deteriorating public health, and disasters), and regional imbalances in urban development. Urban areas striving for sustainability will have to address the increase in urban populations, industrialization and the associated demand for housing that ushers in problematic processes of land use/cover changes; the nature of urban expansion and extension around major urban areas and peri-urban areas that creates severe social and environmental consequences; and the increases in exposure and sensitivity to natural disasters in urban areas.

In conclusion, despite potentials for realizing sustainable urban development, such development generally remains elusive in sub-Saharan Africa. Social sustainability of urban areas would require adequate cross-sectional distribution of urban services to ensure accessibility and improve the conditions of many urban dwellers. The challenges posed by urban growth and expansion to sustainability are daunting by far, given the current experiences of populations with inadequate access to urban services including water supply, sanitation, education and health; while inadequate infrastructure such as drainage systems and roads are exposing urban populations to environmental burdens. The consequences of these conditions are increasing urban poverty and urbanization of poverty. The intertwining of urban poverty and environmental challenges calls for innovative urban management supported by research. This will require a concerted effort that should bring together researchers, policy actors, communities and governments to address such challenges.

The references for this article are available on our website: http://ugec.org/docs/ViewpointsIssue2References.pdf

Urban Vulnerability and Adaptation to Climate Change: Key Issues and Challenges for Nigeria

Felix Olorunfemi

Nigeria is highly vulnerable to the impact of climate change on many fronts considering its geography, climate, vegetation, soils, economic structure, population and settlement, energy demands and agricultural activities. Its location, size, and geographic relief give rise to a variety of climates ranging from the tropical maritime climate of the rainforest located along the coastal and southern sections of the country, to the tropical hinterland climate of the Sahel in the northeast. Nigeria has a population of about 140 million that impacts the physical environment through various activities within an area of 923,000 square kilometres. Sixty percent of people live directly on the natural resource base as farmers, cattle rearers and fisherfolk, while the informal sector constitutes the bulk of the urban population. In all, the level of adopted technology is rudimentary, leading to low output and high levels of poverty. The institutional capacity to manage the urban crisis is also very low. Consequently, the impact of the human socioeconomic activities on the environment is devastating. Climate change has led to a shift in the boundaries of major ecological zones which has resulted in the heightening of drought and desertification in the marginal arid zones of the country; aggravation of soil erosion and flooding in areas of higher rainfall; and salt water intrusion along the coastal belt. Climate change has also altered animal and plant composition in different regions of the country.

Successful national economies depend on well-functioning and resilient urban centres. It is therefore crucial to safeguard the cities of Nigeria against vulnerability to climatic changes, so as to become catalytic to national development goals. For the most prosperous and well-governed cities, adaptation to the likely risks from climate change over the next few decades does not appear problematic. Such action requires adapting buildings and infrastructure to the increasing risks; working with population groups and settlements most at-risk to find solutions that best serve them; and good disaster preparedness. But in Nigeria, as in other developing countries, one cannot adapt infrastructure that is not there. The vulnerability of low-income urban dwellers to climate change is often ascribed to their poverty – but it is far more the result of failures and/or limitations in local governance to ensure

A view of Jus in Nigeria

that needed infrastructure is in place. In addition, the economic opportunities available for people to choose are very narrow and are mostly limited to harvesting the products of nature with rudimentary technology. The institutional capacity for recognizing the enormity of the problem of climate change, enacting appropriate legislation as well as enforcing it is also severely limited. Furthermore, the availability of climate change information is very low and attitudes towards environmental degradation are also very poor. It thus becomes important to integrate adaptation strategies into both municipal and national development plans.

Against this backdrop, the major questions that must be addressed in Nigeria are:

- What are the factors contributing to climate change vulnerability and what are the possible adaptation strategies?
- How can municipal governments in Nigeria be strengthened to effectively plan adaptation to climate change?
- What are the investment options for adaptation programmes and the costs associated with them?

These, among others, are the issues and challenges that must be urgently addressed for climate change adaptation to take place in Nigerian urban areas.

Chronic Vulnerability in Niger Republic:
A Challenge to Urbanization

Oluyemi Fayomi

The Sahel Region is one of the poorest and most environmentally damaged places on earth. Low productivity per land unit is a challenging feature of most dryland ecosystems. Limited rainfall inputs, small and highly localized surface water resources, scant or non-existent vegetation, and low population totals all combine to place constraints on the total productive capacity of both the cultural and physical components of dryland ecosystems. The biggest security threats faced in Africa and in particular, the countries in the Sahel Region of Africa, are economic and social threats including poverty, infectious diseases, and environmental degradation. Most importantly, ecological disaster has become a serious concern to the Sahelian people, particularly in light of climate change impacts. These are concerns of immense importance when one is to consider the preparedness of the Sahel Region for fast-paced urbanization.

Niger Republic, a Sahel country, ranks 177 out of 177 countries in the United Nations Development Programme Human Development Index (2006), thus, ranking it as the poorest nation in the world. The country suffers from endemic poverty, as over 60% of the country's 11.5 million people live on less than one dollar per day. In spite of some progress within the health and education sectors, progress towards the UN Millennium Development Goals is still slow and difficult. In 2004, a severe drought and subsequent locust invasion destroyed up to 100% of the crops in some regions, causing food shortages for more than one third of the population. According to a World Health Organization (WHO) report (2005), an estimated 800,000 children under five years old suffered from hunger, of which 160,000 were moderately malnourished and 32,000 severely malnourished. The most affected were the poorest and most vulnerable agro pastoral regions of Tillaberi, Tahoua, Marah, Diffa, Agadez, Zinder and Gaya. In these regions, pregnant and lactating women, totaling 261,300, and children were most at risk (Niger Fact Sheet, 2005). Furthermore, the majority of Nigerien families are subsistence farmers and livestock breeding plays a key role for these agro pastoralist families. Any loss of livestock or decreases in the market value deprives the household of its major resource and exposes it to food insecurity. Many actions have been taken towards reversing

Downtown Niamey, Niger at night

the effects of degraded lands, but the unknown mechanisms of desertification encroachment can impede results.

Today, there are many strong forces transforming the world; environmental and economic forces are rearranging relations among nations. As the process of globalization accelerates, the United Nations will find itself confronting many of the world's challenges. United Nations agencies specializing in humanitarian efforts have provided relief materials to the victims of ecological disaster in Niger. However, the emergency programs were limited to the provision of relief food, resettlement of destitute pastoralists and sometimes, salvaging livestock. Huge sums were spent on imported relief food to feed drought-afflicted pastoral peoples and other rural communities in Niger Republic, but more attention was given to food supply rather than health risks associated with malnutrition – such as the increase in death from disease outbreaks among people that had been weakened by malnutrition. It is imperative to note that the excessive use of relief food creates dependency and erodes people's initiative to support themselves. Hence, land developments can only occur in view of these concerns and challenges and must be in line with the sociological, political and ecological systems to which these areas within the Sahel Region and Niger in particular, are best adapted.

The references for this article are available on our website: http://ugec.org/docs/ViewpointsIssue2References.pdf

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The Global Institute of Sustainability is the hub of Arizona State University's (ASU) sustainability initiatives. The Institute advances research, education, business practices, and the University's operations for an urbanizing world. Its School of Sustainability, the first of its kind in the US, offers transdisciplinary degree programs that explore and advance practical solutions to environmental, economic, and social challenges.

With over 30 years of environmental research conducted by ASU's Center for Environmental Studies, in 2004, it evolved into the Global Institute of Sustainability established by Julie A. Wrigley. In 2007, the School of Sustainability was formed, offering undergraduate and graduate degrees in sustainability.

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