***Title:** Planning for Climate Resilience at the local level: A Tale of 5 African Cities
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***Report Type:** Research Paper
***Date:** September 2012

***IDRC Project Number-Component Number:** 105868-001
***IDRC Project Title:** Sub-Saharan African Cities: A Five-City Network to Pioneer Climate Adaptation through Participatory Research and Local Action.
***Country/Region:** Namibia, South Africa, Mozambique, Tanzania, Mauritius

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***Abstract:**
This project addresses knowledge, resource, capacity and networking gaps on the theme: 'Strengthening urban governments in planning adaptation.'
The main objective of this project is to develop an adaptation framework for managing the increased risk to African local government and their communities due to climate change impact. The ultimate beneficiaries of this project will be African local governments and their communities. The guiding and well-tested ICLEI principle of locally designed and owned projects for the global common good, specifically in a developing world context, will be applied throughout project design, inception and delivery.

Additionally, the research will test the theory that the most vulnerable living and working in different geographical, climatic and ecosystem zones will be impacted differently and as such, will require a different set of actions to be taken. Potential commonalities will be sought towards regional participatory learning and wider applicability. The five urban centres chosen for this study, based on selection criteria, include: Cape Town, South Africa, Dar es Salaam, Tanzania; Maputo, Mozambique; Windhoek, Namibia; and Port St. Louis, Mauritius.

Through a participatory process, this project will carry out a desk-top study, long-term, multi-discipline, multi-sectoral stakeholder platforms in five Southern African cities comprising of academics, communities and the local government in order to facilitate knowledge-sharing, promote proactive climate adaptation and resource opportunities available for African cities, develop five tailor-made Adaptation Frameworks and explore regional applicability. A network of stakeholders within each urban centre will be established, feeding into a larger regional network of local authorities and partners in Sub-Saharan Africa, and globally through existing ICLEI global (e.g. the ICLEI Cities for Climate Protection programme), ICLEI Africa and UCLG-A members and networks, ensuring global best practice, roll-out, and long-term sustainability.

Key words: Adaptation, Africa, Climate Change, Local Governments, Participatory Action Research, Policy.

PLANNING FOR CLIMATE RESILIENCE AT THE LOCAL LEVEL: A TALE OF 5 AFRICAN CITIES

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BACKGROUND TO THE FIVE CITY NETWORK PROJECT

Increased understanding and awareness of projected climate change risks enables local authority planners and decision-makers to encompass and integrate climate change into planning and development, thus improving resilience of local communities, services, infrastructures and economies. This paper describes the lessons learned in an ongoing project entitled "Sub-Saharan African Cities: A Five-City Network to Pioneer Climate Adaptation through Participatory Research and Local Action" which was initiated by ICLEI – Local Governments for Sustainability - Africa (ICLEI-Africa) under the Climate Change Adaptation Africa (CCAA) program funded by International Development Research Council (IDRC) and Department for International Development (DFID).

The "Five City Network" project encouraged five local authorities, Cape Town (South Africa), Temeke (Dar es Salaam, Tanzania), Maputo (Mozambique), Walvis Bay (Namibia) and Port Louis (Mauritius), to focus on particularly vulnerable communities and their livelihoods, aiming to address the knowledge, resource, capacity and networking gaps by strengthening the ability to plan for, and adapt to, impacts associated with climate change.

INTRODUCTION

Climate change[1] is expected to have direct and indirect physical, social, environmental and economic impacts on cities worldwide. These are anticipated to be felt with greater intensity in the developing world, with Africa, and particularly sub-Saharan Africa, being one of the key regions receiving significant global attention (e.g. Stern 2006; World Bank 2009; German et al 2012). Despite uncertainties surrounding understanding of earth's complex systems, strong evidence in current literature, climate data and analyses demonstrate that, as a result of continued and increasing greenhouse gas emissions: atmospheric and sea surface temperatures (SSTs) are rising, rainfall patterns are changing (causing unprecedented and less predictable floods and droughts); the frequency, magnitude and intensity of storm surges and other extreme events are increasing; and, ocean currents and wind speeds are changing, or at least are becoming less predictable.

[1] Climate Change is defined by the International Panel for Climate Change (IPCC), as a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (IPCC 2007).

A changing climate affects people's access to, as well as the quality of, basic goods and services such as water, shelter and food as well as other priorities for human wellbeing such as health, education and employment. Although all humans are impacted during extreme climatic events, the impoverished find it harder to recover from climate change related impacts since they have limited access to natural, socio-political, human, physical and financial capital (IPCC 2007, McGranahan et al 2007; Douglas et al 2008; UN-HABITAT 2011). Deprivation increases vulnerability to climate change, and climate change in return increases deprivation. Understanding the basis of livelihood assets determines the ability of people to cope with climate-induced vulnerabilities. The key goal is to reduce the vulnerability to changes and to sustain and enhance livelihoods of people, with particular attention to the poor through adaptation and coping mechanisms.

Local governments, as the sphere of government closest to their constituents, are required to make decisions and set directions for promoting social, cultural, environmental and economic well-being. Extreme climatic events and variability impact upon local governments and the day-to-day activities and services they provide to communities within their jurisdiction. These impacts raise challenges and come with risks and vulnerabilities that need to be strategically managed to ensure resilience. Risks associated with climate change pose a serious threat to local governments' ability as service providers to meet their own mandates, yet very few local authorities in developing nations have initiated, let alone completed, adaptation policies or strategies (UN-HABITAT 2011). These threats may arise as a direct result of climate change or indirectly, as a result of a chain or cascade of events.

Adapting to climate change is a necessary initiative to reduce the vulnerability of the natural and human systems. Adaptation as an active initiative is becoming increasingly vital as climatic changes currently experienced are reportedly increasing in magnitude and frequency (World Bank 2009, Somorin 2010). Therefore the magnitude and frequency make the reduction of vulnerability an increasingly difficult task to achieve, particularly for developing nations who, compared with developed nations, have limited capacity and resources to implement coping-mechanisms.

METHODOLOGY

All actions and processes undertaken within this project aimed to focus on the urban-poor, specifically those groupings considered to be highly vulnerable to climate change, e.g. elderly, women and children. Therefore, in all aspects of the project, care was taken to ensure women played an active and participatory role in decision making.

The project approach and methodology embraced the development and use of Participatory Action Research Processes. The overarching objectives of this project were:

- to develop five tailor-made adaptation frameworks for managing the increased risk to African local government and their communities due to climate change impact, and

- to establish a standardized approach for the collection and analyses of climatic base-line data which will assist future localized projections for planning and decision making procedures.

The first phase of the project was to identify impacts and risks associated with climate change variability at the local level, looking at various government sectors. The risk assessment compiled an overview of risks and impacts associated with climate change; a southern African overview of the past, present and projected changes for; sea level, temperature, wind speeds, rainfall and precipitation patterns; and, a cost-benefit analysis of present and projected risks at the local level. The second phase aimed to identify mechanisms for local governments to increase adaptive capacity and climate preparedness, focusing on the identification of locally appropriate adaptation options. Phase three established, and/or added to, Local Climate Adaptation Frameworks (LCAFs) taking into account relevant localized climate change impacts, leading to the implementation of "local smart resilient actions".

Methods used for the process of the Five Cities Network Project included:

1) **Desktop Study:** The desktop study, carried out in conjunction with site visits, with the aim being to assimilate existing knowledge about climatic variables, on local and global scales, and to explore current and alternative adaptation measures, opportunities and strategies.

2) **Stakeholder Platforms:** Three stakeholder platforms (local government, local communities and local academic institutions) were established in each project city to ensure participation from a broad range of actors within each local system. The aim was to increase stakeholder capacity, through active participation, enabling informed and proactive decision-making regarding climate change and its impacts across all sectors.

3) **Project Steering Committees** (PSC) were established for each project city with representatives from the three local stakeholder platforms. The purpose of the PSCs was, and remains, to enable participation, coordination and integration amongst the stakeholder platforms as well as with the other project cities, through ICLEI's networks, and beyond this project.

4) **Workshops:** A series of three workshops was held with the following aims:

1. to identify, understand and assimilate information gathered regarding the predetermined climate variable within each city,
2. to disseminate information; identify local adaptation methods and strategies; and. establish criteria to prioritize adaptation methods and strategies, and
3. to recommend adaptation options for priority action.

5) **Project Outcomes**

- Increased local and institutional capacity and understanding,
- Provide practical intervention to climate change tested at a local level,
- Provide tailor made risk assessments associated with climate change to each project city,

- Two Southern African Climate Change and Adaptation Conferences,
- One Southern African Adaptation competition,
- Local Climate Adaptation reports for each city,
- **Local Climate Adaptation Frameworks (LCAFs)** were developed / improved for each of the five cities, providing tools necessary to broaden and develop methods used in this project, in order to facilitate debate that may arise as a result of implementation of climate change adaptation strategies and policies. Important economic, social and environmental costs of climate change, as outlined in the three previous reports, were reviewed with particular reference to gender impacts and issues. Finally the LCAFs laid out groundwork for a Local Climate Adaptation Strategy and Action Plan (LASAP) for each of the project cities.

The objectives of the process of developing a lessons learned paper have been to:

- to provide an opportunity for cities/ participants to reflect on the process and outcomes in order to draw out lessons learned;
- to enable program partners to prioritize future initiatives, based on the lessons learned from the experiences of five southern African Cities; and,
- to publish a broadly accessible discussion paper that showcases the initiative and the lessons learned, so that other similar initiatives in Africa can build on these experiences.

While a systematic evaluation of the achievements of the Five Cities Network Project does not underpin this paper, the lessons learned are drawn directly from the experiences and perspectives of the participant cities.

CONTEXT OF THE FIVE CITY NETWORK PROJECT

Africa, covering more than one fifth of the total land area of earth, is the second largest continent and hosts one billion people (UN 2010). A continent with abundant natural resources, Africa remains the most underdeveloped continent globally. Extreme poverty, poor access to water, sanitation and health services and malnutrition from inadequate food supplies slows her progress (Sandbrook 1985; UN-Habitat 2008). This means that the average sub-Saharan African will bear a three-fold population-based risk of suffering adverse effects of climate change when compared to a global total (Byass 2009), a heavy burden to bear for the population group that has contributed least to the forcing of climate change (IPCC 2007). The Stern Report (2006) concludes for Africa that the poorest are most likely to be severely impacted, warning of reduced agricultural production caused by rising average temperatures, as well as increased disease and health impacts, a view supported by many other researchers and reports (e.g. Myers et al 2011).

Climate projections for Africa

Temperature: Africa is experiencing the same physical effects of climate change and variability as experienced worldwide. Consensus in the scientific community's projections indicates warming of approximately 0.7^{O}C, but more so in the southern than in the central regions (IPCC 2007). These

warming trends are anticipated to alter precipitation, accompanied by sea level rise and increased frequency of extreme events in Africa, such as sea storm surges, floods, gale force winds and cyclones (Desanker 2009). In the Southern African region, temperatures in parts of southern Africa are projected to increase by as much as six degrees Celsius, with rainfall reduced by up to 40 per cent (Palitza 2009).

Various other authors have projected future air temperatures with the use of Global Circulation Models and Regional Climate Models under different emissions scenarios and a selection of these temperature projections for the African continent include: a temperature increase of 7°C for southern Africa between 2070 and 2099 (Ruosteenoja *et al.* 2003); temperature increases of 3.7°C in summer and 4°C in winter in southern Africa by 2080 (Hudson and Jones 2002); and, warming across the continent by 2100 ranging between 0.2°C per decade (low scenario) to over 0.5°C per decade (high scenario) (Hulme *et al.* 2001 and Desanker and Magadza 2001).

Rainfall: Again, various projections for different parts of Africa predict a 10-20 per cent decrease in rainfall by 2070 and a fall in river-water levels of as much as 50 per cent by 2030, (UNECA 2010). Importantly, projections indicate that 230 million Africans will face water scarcity by 2025 as a result of decreasing water resources and as a result of increasing constraints on water resources, especially in hotter climates (UNECA 2010).

Frequency, magnitude and intensity: Tropical cyclones are likely to intensify, as a result of increased sea surface temperatures IPCC (2007). Scientific, peer reviewed studies used to inform the IPCC (2007) assessment, as well as studies published subsequently, indicate that climate change will affect the intensity, frequency and paths of strong storm and wave events. They also indicate a global trend towards increased intensity of hurricanes over the past few decades – most notably in the North Atlantic and Indian oceans.

Vulnerabilities

Africa is particularly vulnerable to climate change and associated climate variability as the situation is aggravated by the interactions of 'multiple stresses'. These 'multiple stresses' include:

i) endemic poverty, complex governance and institutional dimensions,

ii) limited access to capital, including markets, infrastructure and technology,

iii) ecosystem degradation, and

iv) complex disasters and conflicts.

These in turn have contributed to Africa's weak adaptive capacity leaving the continent most vulnerable to deal with impending changes (IPCC 2007).

Agricultural production, including access to food, in many African countries and regions is projected to be severely compromised by climate variability and change impacting food security. Countries dependent upon rain-fed agriculture will be impacted (IPCC 2007) with small-scale farmers being the most affected (Venton 2007).

Climate change will aggravate the water stress currently faced by some countries, and place others that do not experience water stress at risk. Climate change and variability are likely to impose additional pressures on water availability, water accessibility and water demand in Africa. Even without climate change, several countries in Africa, particularly in northern Africa, will exceed the limits of their economically usable land-based water resources before 2025. About 20% of Africa's population (~200 million people) currently experience high water stress. The population at risk of increased water stress in Africa is projected to be between 75-250 million and 350-600 million people by the 2020s and 2050s, respectively (IPCC 2007).

Climate change is likely to alter the ecology of some disease vectors in Africa, affecting the spatial and temporal transmission of such diseases. Most assessments of health have concentrated on malaria, since over 90 per cent of estimated global malaria deaths in 2011 were in Africa (WHO, 2011). However the need exists to also focus on vulnerabilities and potential impacts of future climate change on other vector-borne diseases (such as dengue fever) as well as those spread by floods and inadequate services (such as typhoid and cholera). This highlights a great need to concentrate on climate change adaptation measures to circumvent and limit spread of these diseases.

Impacts of local climate change are likely to depend more upon changes in the frequency of extreme events than on changes in the average conditions. Increased frequency and/or severity of extreme events will increase human vulnerability to natural disasters such as droughts, floods, mean sea level rise and storm surges and cyclones. Semi-arid areas, coastal areas and deltaic regions are particularly vulnerable, and sea-level rise will affect many low-lying coastal areas with large populations.

Some key responses: programmes and political commitments

Some key related and ongoing programs focused on climate change and adaptation in Africa provide an important context for the Five City Network Project. Significant in its impact is the overarching Climate Change Adaptation in Africa (CCAA) research and capacity development program, a six-year joint initiative of IDRC and the UK Department for International Development (DFID). The program which ran from 2006 to 2012 sought to significantly improve the capacity of African people and organizations to adapt to climate change in ways that benefit the most vulnerable. It provided support to 46 projects and enabled research in 33 African countries and 212 Africa-based organisations were involved in implementing CCAA projects. Second-phase funding for two projects, the African Climate Change Fellowship Program (ACCFP), which supports African professionals, researchers, educators and graduate students to undertake activities that enhance their capacities for advancing and applying knowledge for

climate change adaptation in Africa and AfricaAdapt, an independent bilingual network (French/English) focused exclusively on Africa to facilitate the flow of climate change adaptation knowledge for sustainable livelihoods between researchers, policy makers, civil society organizations and vulnerable communities.

The United Nations Development Programme's (UNDP) Africa Adaptation Programme was launched in 2008 in partnership with the United Nations Industrial Development Organization (UNIDO), the United Nations Children's Fund (UNICEF) and the World Food Programme (WFP) with support from the Government of Japan. The AAP is engaging 20 African countries in creating the environment in which more informed and appropriate adaptation decisions and practices can be undertaken within the context of sustainable development.

There are also recent commitments by local government that address climate change issues which provide an important backdrop to the Five Cities Network Project. These include the *African Local Government Declaration on Climate Change* that emerged from the African pre-Copenhagen Local Government Climate Roadmap Summit convened by ICLEI – Local Governments for Sustainability – Africa, UCLGA and partners, in 2009; and, the *African Mayors Climate Change Declaration* of 2011 which was an outcome of the Local Climate Solutions for Africa 2011 which prioritised key concerns of African local governments ahead of the United Nations Framework Convention on Climate Change Conference of the Parties 17 (UNFCCC COP17).

A further key milestone in political commitments by local government was the Durban Local Government Convention in 2011, convened by ICLEI Africa in partnership with South African Local Government Association, South African Cities Network (SACN), eThekwini Municipality, and the National Department of Environmental Affairs as a parallel to the UNFCCC COP 17/CMP 7 climate negotiations. This culminated in the formulation and adoption of the *Durban Adaptation Charter*. To date there are a total of 416 African local governments which are committed to the *Durban Adaptation Charter*. The Durban Adaptation Charter commits Local Governments to local climate action in their jurisdiction that will assist their communities to respond to and cope with climate change risks thereby reducing vulnerability.

RISK AS A CLIMATE CHANGE CONCEPT

Risk has been a dominant feature of urban discourse over the past decade (Ernst and Young, 2011) double-dip recessions, terrorism, currency fluctuations, epidemics, water scarcity and on top of all of this, climate change.

Risk can be a useful way of understanding the many and varied ways in which climate change might impact on different aspects of society, the economy and the environment. The fact that the concept of

risk is familiar to banks, governments and households, is important in mobilizing climate change responses from these different quarters. But what exactly do people mean, and understand by climate change risk, is it possible to compare this risk to the threat of terrorism, and how is the concept useful in reducing climate change impacts?

Risk is usually calculated by multiplying the probability of an event happening by the damage or cost that is incurred when that event happens. What needs to be acknowledged, however, is that the timing, nature and extent of climate change damage is both deeply uncertain and difficult to attribute to increased concentrations of greenhouse gases, particularly at the local level. In this sense, while actuarial quantifications of climate change risk can be useful in raising awareness and making comparisons, these quantifications are always likely to be contested, based on the assumptions they make. The quantification of risks can also, too easily, conceal important attributes of specific risks; attributes that need to be understood if the risk is to be addressed.

A deeper understanding of climate change risk helps to highlight why climate change is a particularly difficult risk to manage and why local governments need to be proactive in managing this risk:

- The lag between the emission of greenhouse gases and the warmer atmospheric temperatures that cause harm, means that by the time society thinks it is critical to reduce the emissions of greenhouse gases, it may be too late and local municipalities may be experiencing 'run-away' impacts.
- The unprecedented nature of climate change risk makes it difficult to anticipate and manage. Neither individuals nor institutions are good at preparing for, or dealing with, risks with which they are unfamiliar.
- The risk cannot be addressed by a single municipality acting in isolation and yet the required collaboration is undermined by the fear that taking responsibility might be costly and the hope that others will bear the brunt of the burden.

Where risk analysis leads to a better understanding of climate change it can also highlight important aspects of what constitutes effective climate change action. Firstly that the cost of climate change risk can be reduced by judicious early action and secondly that actions which look to reduce systemic risks by focusing on the ability of society, the economy and the built environment to cope with change, are likely to be most effective.

DESCRIPTION OF THE FIVE LOCAL PARTNERS AND THEIR RESPECTIVE CONTEXTS

The five urban centres chosen for this project are Cape Town in South Africa, Temeke Muncipality (Dar es Salaam) in Tanzania, Maputo in Mozambique, Walvis Bay in Namibia and Port Louis in Mauritius (see Figure 1).

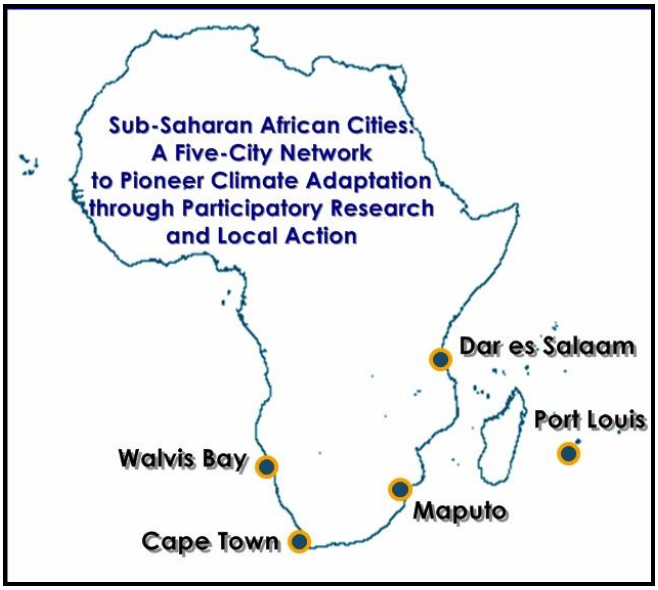

Figure 1: Map indicating the location of the participants in the Five City Network Project

These cities were chosen as they are large; home to a significant number of people; are rapidly developing; are coastal economic hubs with harbours that contribute to their national GDP; and, all are members of ICLEI - Africa. Port cities form a nexus between growing population and trade, and are thus an excellent focus for investigating impacts and adaptation needs under changing climate.

Each of the five cities is presently threatened by existing climatic risks and challenges, which the citizens, local authorities and politicians recognize as threats to livelihoods. All five countries and/or cities possessed basic or better environmental legislation adequate for mainstreaming adaptation. Adaptation needs to be initiated quickly so that each city can contribute to the understanding of climate change, its vulnerabilities and adaptation strategies.

Table 1 provides presents a summary of key contextual information for each participant city as well as a summary of the key areas of intervention.

Table 1: A brief description of the five cities and city districts comprising the project network

City/town Description	Cape Town (South Africa)	Maputo (Mozambique)	Port Louis (Mauritius)	Dar es Salaam (Tanzania)	Walvis Bay (Namibia)
City/town district	Mamre	Chamanculo "C" community		Temeke Municipality	
City/town population estimate	3.5 – 4 million	2 – 2.5 million	150 thousand with a "moving" population estimated at around 300,000	4.5 million	60 thousand
District population estimate	7,300	26,000	n/a	1 million	n/a
Altitude range	0 – ±400 m	0 - ±85 m	0 - ±300 m	0 - ±200 m	0 - ±63 m
Land area (city)	2,461 km²	347 km^2	6,010.5 ha	1,393 km^2	1,124 km²
Climate	Mediterranean - temperate	Sub-tropical – humid	Tropical	Tropical	Semi-arid to arid coastal climate moderated by cold Benguela current
Existing threats / vulnerabilities	• Increasing temperature • Sea level rise • Drought • Flooding • Saltwater intrusion • Coastal erosion	• Sea level rise • Cyclones • Flooding • Increasing temperature • Disappearance of mangroves • Saltwater intrusion • Erosion • Coastal erosion	• Cyclonic winds • Sea level rise • Increasing temperature • Decreasing rainfall • Flash floods • Coastal erosion and tidal surges	• Flooding • Sea level rise • Drought • Increasing temperature • Disappearance of mangroves • Saltwater intrusion • Erosion • Coastal erosion	• Tidal and storm surges • Damage to residential, key industrial and municipal infrastructures • Sea level rise • Increasing temperature • Saltwater intrusion • Erosion • Coastal erosion

Focus "Five Cities Project" GCC issue	Increasing temperatures and effect on livelihoods	Flooding and sanitation risk	Cyclonic winds and adaptation measures	Flooding	Sea storm surges and inundation of low-lying urban areas
City/district project/s and actions	• Mamre ceilings retrofit project: monitoring the effect of ceiling installations upon livelihoods of local communities	• Adapting Sanitation Systems to Climate Change through participatory research and local action in Maputo • Reconstruction of the National Disaster Management Institute • Two new departments for environmental inspection and management	• Port Louis Adaptation Framework • Participatory Slum upgrading programme • "one citizen – one plant" Campaign • "Port Louis Vision 2020" - The first zero carbon city in Africa	• Dar es Salaam Resilient Action Plan • Community Infrastructure Upgrading Programme • Informal settlements Plot survey Project • Resettlement of communities affected by floods • Replanting mangroves	• Walvis Bay Adaptation Framework • Walvis Bay Environmental Management Forum (WEMAF)

LESSONS LEARNED WITHIN THE LOCAL PROCESSES

City of Cape Town

The Mamre Ceiling Project, which focused on the retrofitting of ceilings to reduce temperature effects on livelihoods, noted a number of issues emerging from the initial stages of research that required more focus. These included a need for further research aimed at identifying indicators and assessing baselines to enable improved monitoring and evaluation of results.

Issues which were identified included ensuring rigorous assessments of, for example, the thermal performance of installed ceilings; breakdowns of energy consumption; and detailed energy sources for heating houses; a rigorous cost benefit analysis of the programme; a means of assessing electrical use in households (what energy is used for appliances, etc.); assessment of the costs of energy sources including whether for heating or cooling houses. Information required includes baseline and monitoring data with regard to climate resilience of households; health improvements and livelihood strategies; and, behavioral changes in energy usage.

In addition, interview and survey methods need to be improved in order to adequately capture and reflect social feedback mechanisms regarding the "feelings" of the participants regarding the project, as well assessing their interest in taking future climate change/energy actions. In other words improved survey "metrics" would contribute to improved results for future investment. For example, one of the

results of this project has been a reduction in the incidence of tuberculosis; however this has not been supported in baseline and monitoring evidence, but is qualitative feedback from project beneficiaries.

The City of Cape Town identified a number of Five City Network Project process and implementation benefits, including that the forum: was excellent for learning and networking (good program and facilitation); had tangible outcomes (ICLEI's role was to research and evaluate outcomes); made people at all levels realize the gravity of climate change; and, made climate change 'real' or tangible.

Maputo

Maputo's challenge to manage storm-water successfully has been met in a number of ways. These included an infrastructure solution, namely storm-water canals requiring strong local government leadership and extensive community consultation. Ownership by the community was evidenced by community agreement to movement of property boundaries as well as the active removal of objects from canals.

Maputo reported that strategic planning and a systematic approach is necessary, and that this requires good governance; financial stability; institutional capacity; as well as infrastructure and service delivery.

This approach provided the key ingredients for climate change adaptation since the adaptation measures increased drainage systems thereby reducing damage and erosion. Health improvements included reduction of stagnant water and decreased direct flooding impacts. Further, an important vehicle of success of the process was considered to be the adoption of the local language as a working tool.

Of significance is that the Mozambiquan National Disaster Management (INGC) early warning system plays an important role in warnings, but the role of the media remains extremely important. The use of mobile networks (SMS, etc.) for early and advance warnings can be effective, but does have some drawbacks. These include an inability to feed back into the network – in order to monitor assess and evaluate how the message is received and understood.

Maputo identified a number of Five City Network Project process and implementation benefits, including that there was good community involvement and high level political support, even though the interventions were initiated later than in the other cities on the network. A key lesson learned is the essential role of a technical focal point within local government.

Port Louis

Port Louis, home to a large proportion of the main island's population, will be the city most affected by the impacts associated with increased intensities of cyclones, sea level rise and other projected climate changes. Port Louis is already prepared for cyclones but the intensity and frequency of projected

cyclones is likely to strain current adaptation. This coupled with rising sea-levels will affect all local government sectors.

Provisions needed to be reviewed in terms of wind gusts and energy infrastructure. Frequent failures of steel latticed towers indicated inappropriate design for the wind speeds and/or the unknown behavior of such structures under the dynamics of a cyclone. Furthermore, design provisions for torsional resistance of these towers under the worst case of swapping of wires also required review. Construction quality is strictly maintained in concrete distribution poles. Design practices required review to provide adequate strength to resist torsional forces (for example transmission towers) (Raju and Sinha 1998).

To this end, Port Louis identified community based, institutional, biophysical, infrastructural and "retreat" adaptation options.

Community based adaptation options included a variety of infrastructural adaptations including the establishment of roof gardens and revegetation of exposed soil areas; securing all structures (to avoid damage as well as loss of property or assets); Communication, Education and Public Awareness (CEPA) of necessary Medicinal options and treatment facilities; and, Community involvement (especially at refugee centers).

Institutional adaptation options included, amongst other: establishing a Key Stakeholder Platform to inform decision making processes; structural building guidelines; limiting low lying development; and, preparation of risk and Vulnerability Maps.

Biophysical adaptation options included establishing and increasing permeable surfaces to improve water infiltration and not evaporation (increased humidity) during increased winds and high temperatures; vegetating areas to limit windblown sand; and, re-establishing coastal areas to protect natural dune buffers.

Identified infrastructural adaptation options ranged from structural wind breaks to reduce wind in certain areas; underground cabling to reduce disconnection of energy supply during high winds; raising harbor defenses to protect the harbor facilities from sea swells during strong wind events; ensuring availability of pumps and generators at medical facilities in times of power outages; and, wind breaks along coastal areas to protect terminals and storage petroleum units at the Port Louis harbor.

Finally, retreat adaptation options for Port Louis included a variety of measures for moving and or relocating transport routes, clinics and hospitals, water treatment plants, fuel storage tanks, power stations and supply terminals, as well as harbor associated infrastructure.

Port Louis reported a number of benefits arising from the Five City Network Project process and implementation. The city reports that an uncoordinated Climate Change Adaptation response prior to ICLEI Involvement was improved by the project since it helped coordination through process; enabled

prioritization; assisted with leveraging resources; built community awareness (Green army); improved communication; and, aided institutional embedding.

Port Louis also noted that follow-up is challenging, and that expectations of the citizens and the local authorities are high. They suggested the formation of a climate change committee to enable follow-ups.

Temeke Municipality

Dar es Salaam, the most populous city in Tanzania, will be heavily affected by increasing drought and coastal flooding. Greater Dar as Salaam, and Temeke Municipality in particular, are vulnerable at all municipal sector levels. Already many citizens suffer health stresses, which will be further exacerbated by climate change. Transport and energy networks will be placed under even more strain by increased demands as more 'economic' migrants seek work in the city. Dar es Salaam and Temeke, will struggle to meet development goals designed to improve the livelihoods of their residents. The need for clean water and good sanitation is a common thread, affecting all sectors.

The authorities identified several challenges including a low level of awareness on climate change issues among decision makers; proper institutional arrangements, clear policy and strategies at the local level (to address climate change and related issues towards development of a resilient city) were lacking; and, the city had limited financial resources to overcome increasing threats from climate change and associated risks against competing needs.

In response to these challenges, they propose to initiate training on climate conducted with the cooperation from other stakeholders; create a specific unit to deal with climate issues and inclusion of the Dar es Salaam Resilient Action Plan (DRAP) in the City Strategic Plan); and, institute revenue enhancement programmes.

Some concerns raised are that urban population influx (4.6 per cent per annum) imposes a threat, particularly since there is a lack of basic services in informal settlements and there are no clear policies at local levels to support climate change issues and programmes. Further, activities on climate change issues and programmes are unco-ordinated and there is limited budget allocation to support adaptation projects to climate change and natural hazards. Budget guidelines, support and final approval come from the National Government although in response to this issue, efforts can be, and are, combined through the Association of Local Authorities in Tanzania (ALAT).

Some of the local lessons learned were that the ecological and hydrological role of wetlands is not well understood or incorporated in urban development planning and that clear policies should be in place at local level towards building a resilient city. A joint effort by local authorities and other key stakeholders is necessary to address climate change challenges and risks, with awareness creation and capacity building at local levels being a critical basis for future development of a resilient city. Finally, climate

change adaptation and risk reduction can be best addressed in a sustainable manner in Dar es Salaam through integration with urban planning and management practices.

Benefits from the Five City Network Project process and implementation identified by the Dar es Salaam report included that all three workshops were beneficial, as was the SMART goals – handbook. The methodology (e.g. using photographs, community involvement, field visits and action research) was good and the process made climate change real since the city is already experiencing the impacts of climate change. There was a wide range of participants and the field visits and action research helped to identify priority districts and issues.

Walvis Bay

Mean sea level rise, coupled with sea storm surges threaten the town of Walvis Bay, which is protected by a narrow sand bar known as Pelican Point. Kuiseb River delta flooding further periodically threatens this harbour town.

Walvis Bay faces a number of challenges and constraints, identified during the Five Cities Network Project as including resource constraints; lack of relevant back-up legislation; low awareness levels by public and authorities; possible conflicting and/or duplication of efforts; migration into urban areas (relatively rapid urbanization); inability to strike a balance with respect to sustainable development; and, levels of uncertainty with regard to the effects of climate change.

The local authorities identified that political- and urban management support and willingness to face the challenge was intact however, due to lack of expertise and inadequate funding, the town was in crisis.

During the project, the Walvis Bay community solidified partnerships which strengthen and supplement its support base, and participated in capacity development initiatives, willingly accepting and contributing to the pool of knowledge, advice and assistance towards building a resilient port city.

Some of the actions Walvis Bay has taken include stabilizing the Pelican Point Sand Spit; installing a flood-proof dewatering abstraction system; systematically establishing a storm-water drainage system; incorporating climate change and support in the implementation of the Walvis Bay Integrated Urban Strategic Development Framework; and providing input and support in the implementation of the Walvis Bay Climate Change Strategic Action Plan and the Walvis Bay Resilience Handbook.

During March 2011, the Walvis Bay Environmental Management Advisory Forum (WEMAF) was established. This forum is a platform adopted by council, to advise local governmental politicians on environmental matters. Ensuring effective, efficient and practical collective ways of managing the local environment, WEMAF is a broad-based multi-stakeholder platform. Acting as a science reference base for local, regional and national government, community representatives as well as the public and private sectors, it increases capacity building and enhanced knowledge exchange.

As part of the strategy to adapt to climate change, Walvis Bay interpreted institutionally based actions as a strategic policy directive (pledging support to the Walvis Bay Integrated Environmental Policy and to promotion of LA21 sustainable development principles). They further sought strategic partnerships (e.g. the Five City Network and the UN-Habitat Cities and Climate Change Initiative). Strategic co-ordination is being undertaken through the WEMAF and production of Walvis Bay Climate Change Strategic Action Plan); and they have revised the Municipal Development Public Private Partnership to consolidate demographic ideas and create synergy in development efforts.

Some of the benefits of the Five City Network Project process and implementation for Walvis Bay participants included the opportunity to network at a variety of levels, from local to international, as well as opportunities for raising awareness.

Shortfalls of the Five City Network Project for Walvis Bay, were that the project was not specifically directed along precise, predetermined guidelines, but was rather based on a "learning by doing" approach. The suggestion for predefined implementation projects to be added to similar projects, which would produce tangible results.

Lessons shared and learned between the project cities

All participants concurred that if a city is unable to adequately meet its mandate of basic service provision, the ability of the average resident to make a living is impaired and a decrease in the quality of life is inevitable. Already all five cities were shown to be unable to meet the needs of some sectors, in particular the burgeoning informal settlements, in other words those people who are most vulnerable to the changing climate.

It is critical to make plans now to ensure as much resilience as possible to prevent major catastrophe and to allow local government sectors to continue to meet their mandate of basic service provision. Mitigation and reducing emissions and energy efficiency is important, but adaptation is a more vital component in the southern African sub-region in order to prepare and increase resilience towards the risks and impacts. Local authorities need to adapt and plan strategically to build resilience against the vagaries of climate change.

There is a need for adaptation strategies and preparedness in protecting local communities and the environment on which they depend upon for their livelihoods and well-being. Livelihoods in fact became an integrating theme throughout the project.

Inputs to the project from all sources, the local authorities and communities of the five cities, international and other technical advisors and experts, provided a suite of summative and formative lessons learned.

Shared lessons, focusing on the results of the project, included:

Global and regional climate models are not always the most effective means of identifying potential risks at the city or local level. Understanding local level risks requires good understanding of types, causes, probabilities and occurrence of climate change challenges and threats peculiar to that city. For the city to address risk, it is most important to recognize and concentrate on immediate risk. Within this framework, both response and mitigation can play a part in devising and implementing an adaptation strategy.

Investment in identifying risks and threats, as is ensuring that it is widely accessible at all levels. Investment in adaptation is similarly of high value since it improves preparedness and response to disaster. Economic information and economic arguments must strengthen and highlight proposals and actions wherever possible.

All stakeholders should be involved from as early as possible, ensuring that the appropriate departments and officials are involved and committed from the outset. In order to reduce conflict, or waste resources, use existing processes / initiatives / institutions / civil groups where possible and identify local leadership and champions. Understanding and working with local values is important and all outside assistance must accommodate local philosophies, language and ideals. Similarly, all experts and specialists used for any project, whether local or international, must have the respect of, and respect for, all stakeholders, providing understandable and accessible information regarding technical data and solutions.

Appropriate feedback mechanisms, which allow passage of communication both ways, can improve buy-in and regular involvement by the community and other authorities. For this reason it is also wise to ensure good formalized communication between cities and/or countries, in order to improve and facilitate learning.

Robust assessment and feedback as well as a monitoring and evaluation component should be built into climate change adaptation projects and programs. Adaptive feedback mechanisms afford the participants the opportunity to review and refine their approach, perception and strategy.

Shared lessons, focusing on improvement and enhancement of an expanded or similar programs

Climate change adaptation is a social-institutional learning process. When past planning is no longer a good proxy for future planning, new planning values and standards must be sought with a paradigm shift from “certainty of impact” to “certainty of response”.

It is imperative to adopt a forward-looking approach, which aims to avoid the mistakes of the past. This must be risk-based; a strategy based on implementing “the right balance” of structural and non-structural measures and part of participatory urban and land use planning, working across sectors and jurisdictions. Resilience can be built by mainstreaming risk reduction into urban management with institutional economic infrastructural and social component elements.

Both market- and non-market related solutions must be sought, since given uncertainties and unknowns it is complex, if not impossible, to always define damage functions and possibilities within actuarial terms.

There must a focus on systemic risk reduction, with efforts to curb and contain the socio-ecological spiral described by Chan et al (2011) and a critical to move from risk measurement to behavioral change. There nonetheless remains a need to recognize and understand "coping".

Unintended consequences of improved infrastructure interventions must be understood; better servicing can drive up land values and can cause gentrification of areas where these improvements have taken place. This effectively displaces poor people who cash in on the short-term benefit of selling their properties; moving social risks to another unsafe/unserviced area.

Decision-making must be more robust, forgetting about optimal design and anticipating all risks, traditional cost-benefit analysis does not work when dealing with catastrophic "tail" risk. Focus instead on "robust" design, investing in data, preparedness and response and develop robust indicators. It is important to enable long-term technical capacity and sustained community communication, education and awareness.

Balancing policy tradeoffs between risk reduction, urban development and poverty reduction is difficult and land use policies are most instrumental to prevent building and settlements in high risk areas, but these are not always popular. Proactive sites-and-services projects reduce risk, but often in the periphery while efficient public transport systems can increase land supply with access and mobility however, these can result in urban sprawl. Investing in slum upgrading and basic service provision reduces risk, but sometimes resettlement will be necessary.

Climate change adaptation strategies and plans must be integrated at the most strategic development planning level. Climate change adaptation must address development priorities, be integrated with Disaster Risk Reduction strategies. Climate change adaptation strategies must be developed in an integrated manner, engaging the appropriate political leaders, local authority technical experts and utilities and communities.

All participants in the project have emphasized the importance of learning platforms for exchange (including the Resilient Cities Congress; Local Climate Solutions for Africa congress in Cape Town, the Durban Local Government Convention). These events have ensured that both the technical and political capacities of African local governments have been engaged in local-level climate change adaptation processes through the conferences and mayoral round table events.

Cost-benefit analysis and climate change adaptation

It is too early to know what constitutes successful climate change adaptation at the local level, and yet some things are already clear when looking at efforts to manage climate change risk. It is, for example, obvious that well-meaning efforts to make the problem better can make it worse if they are not well thought-through, well-designed and well implemented. It is also clear that some adaptation efforts are more cost-effective than others.

Given that all cities operate under fiscal constraint, it is important to prioritize adaptation efforts in terms of their economic efficiency: good adaptation efforts should deliver a big "bang for buck" and cities should fashion their adaptation efforts to fit their budgets. While it is possible to use economic instruments such as cost-benefit analysis in identifying economically efficient adaptation efforts, it is very easy for such instruments to produce "nonsense" answers that mis-allocate scarce resources. This is mainly due to the difficulty in defining "benefit" in the climate change adaptation sphere. In theory the "benefit" arising from climate change adaptation should be the amount of loss that was avoided by effective adaptation. That would be simple if it was possible to know exactly what climate change impacts could be expected, the timing of those impacts and their economic consequence. The uncertainty that is introduced by climate change makes such foresight with regards to impacts, impossible and confounds the use of many economic instruments in the process.

To address this problem eThekwini Municipality introduced an innovative and effective means of applying cost-benefit analysis to prioritize their 48 adaptation options in an economic manner. Instead of trying to work out how much economic value could be saved by adaptation, Durban calculated "benefit" based on the number of people reached by each adaptation effort, the frequency with which they were reached, and the extent of the positive impact on those people. It made for a different, but effective prioritization in which people and not GDP were the focus. Given that most cities have better demographic records than GDP data the approach makes further sense. By comparing this notion of benefit with the cost of implementing the different adaptation options (costs are relatively easy to establish) Durban was able to come up with a cost-benefit ratio for each of the options. It was these ratios that helped Durban get the most out of its expenditure on climate change adaptation.

The approach is significant in that it allows for decision making in spite of uncertainty. Instead of trying to predict every climate change impact to perfection, it values the more important ability to respond to a wide-rage of inherently difficult to predict climate related contingencies (pers. comm., Anton Cartwright).

CHALLENGES AND OPPORTUNITIES FOR THE FUTURE: THE POTENTIAL LEGACY OF THE 5 CITIES PROGRAMME

The initiatives developed within the Five Cities Network Project could be taken forward in many ways. Participants at a Project workshop discussed potential options for enabling an ongoing legacy of the

project. The key suggestions include the ongoing evolution of the tools developed through the Project and the expansion of the City-based programs to include other relevant climate change variables within an expanded process, thus enabling a full suite of adaptation options and strategies to be identified and considered within local government development plans. Using the political will and technical capacity developed within the project partners, suggestions have been made for project roll-out to neighboring local authorities or for the mayors to champion a national roll-out within each country. A larger vision is for the network to be broadened to an African network of cities, possibly by focusing on the local authorities which have made a commitment to the Durban Adaptation Charter.

Critical in creating a legacy in the form of a larger network that can refine the methodologies and tools developed in the Five Cities Network Project, are ensuring that momentum is not lost in the partner cities and resourcing a large-scale intervention that can carry forward opportunities identified through the project.

CONCLUSION

A city's confidence in response and common approach in risk assessment must surely by necessity encompass both the upstream and downstream of the food, energy and master supply chain. Without cities addressing the imbalance of economics of the city dwellers (the gap between the poor and the rich) resilience activities will not be implemented, or will be insufficiently implemented, within the poor communities. Climate Change Adaptation in the context of urban development in Africa must address poverty directly by ensuring that the most vulnerable are at the centre of Disaster Risk Reduction strategies.

Climate Change Adaptation should always be seen as an integral part of strategic development plans for cities, in this way relevant interventions can be "mainstreamed" into implementation programs and projects.

The lessons learned from the Five Cities Network emphasize the notion that Climate Change Adaptation is a process of social and institutional learning rather than a discrete set of pre-determined strategies. Critical to supporting the process of social learning are the information bases that can assist in risk assessments and strategy identification and support cost-benefit analysis of potential strategies and enable robust monitoring and evaluation mechanisms to enable this essential evidence-based learning.

"It is increasingly important to gauge the value of pre-emptive adaptation strategies that increase resilience and decrease vulnerability, against the cost of damages if these measures are not put in place" (Tadross and Johnston 2012).

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