Strengthening climate resilience in African cities

A framework for working with informality

By Anna Taylor and Camaren Peter, African Centre for Cities

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Village One, Mathare Valley, a slum in Nairobi.

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1. Introduction

The idea of 'climate compatible development' is gaining ground in international policy circles. It is aimed at fusing the climate change adaptation and mitigation agendas with the mainstream development agenda. This raises a key set of questions, especially where African cities – and other developing world cities – are concerned. What opportunities and challenges does this present in the context of rapidly growing cities across the African continent, where two key features are widespread: informality and deeply entrenched inequality? Informality comes in many forms, including settlement on unplanned land without public services and bulk infrastructure; unregistered housing construction and transfer; informal and insecure jobs; and unregulated trade and service provision.

In the light of the threats posed by changing climatic conditions and the prevailing realities of economic and political disempowerment, how might we go about grounding and working with the idea of climate compatible development so that we can envision and build new urban futures in cities across Africa that are vibrant, inclusive and sustainable? This document is intended mainly for use by city practitioners operating in local government agencies and civic organisations. It distils a set of eight principles for engaging in such development work, and suggests an eight-step process as a guide for undertaking climate compatible development in African cities that factors in climate dynamics alongside the socioeconomic, spatial and political dimensions of development.

2. Urbanisation and climate change in Africa: Global trends, local impacts

As climate change becomes increasingly acknowledged as a key driver of global, regional and local-scale impacts that exacerbate the vulnerability of human systems, the question of how to conduct 'climate compatible development'[1] within urban systems has become more pressing. This is because the planet is currently mid-way through the second global wave of urbanisation, which is proceeding on a scale and at a rate that is historically unprecedented. Moreover, this second wave of urbanisation is largely taking place within the slums and informal settlements of developing-world cities in Africa and Asia, where multiple pressures combine with climate change impacts to exacerbate pre-existing vulnerabilities and inequalities.

The first wave of urbanisation occurred during the Industrial Revolution, between 1750 and 1950, when approximately 400 million people urbanised in roughly 200 years.[2] The second wave, considered to span 1950 to 2030, is projected to consist of roughly 3 billion people urbanising in 80 years. The majority of the second wave of urbanisation is occurring in Africa and Asia, in cities that are the least equipped in terms of governance, infrastructure and economy to absorb this staggering, compressed growth. Cities that lack infrastructure, local government capacities, service provisions, opportunities for employment, and which are characterised by high levels of slums and informal settlements, will absorb the bulk of global urban growth as the second wave of urbanisation unfolds.

This brings into stark perspective the nature of the global urban development challenge that is emerging alongside the imperative of responding to global anthropogenic climate change. The challenge for African cities is particularly acute. According to the revised World Urbanisation Prospects data released by UNDESA,[3] the African urban transition is projected to see Africa's urban population rise from approximately 33 million in 1950 to 744 million in 2030, and over 1.2 billion by 2050. Currently, African cities are characterised by high levels of slums and informal settlements, reaching proportions as high as 60–80% in some East, Central and West African cities. These cities are also characterised by the demographic dividend referred to as the 'youth bulge', where more than half of the continent's population is 17 years of age or under. In addition, only 28% of employees earn stable wages, whereas 63% are in insecure jobs. Even the much-vaunted 'African middle class', defined as those earning between US$2 and US$20 per day, consist of 60% earning between US$2 and US$4 per day.[4] The latter group, referred to as the 'floating middle class', can drop back into poverty relatively easily due to their high levels of vulnerability to the effects of economic, political and environmental changes occurring largely outside of their control or influence, especially those that increase household living costs (e.g. increases in food and fuel prices) and damage household assets (e.g. large storms and heavy rains). Many of the floating middle class in Africa are residents of urban informal settlements, living in houses and apartment blocks that have bypassed planning and building regulations, in areas with minimal bulk infrastructure and public services, such as waste collection and management, public transport, clean piped water, health facilities, recreation and other amenities.

African cities are vulnerable to a variety of climate change impacts, ranging from gradual shifts in temperature, intense rainfall, rising sea-levels, coastal erosion and groundwater salinity to changes in the frequency and/or severity of extreme events, such as fires, floods, heat waves and storm surges. Slum and informal-settlement dwellers often reside in particularly high-risk locations within the city, often on marginal land avoided by regulated property developers, and lack the requisite infrastructure and services to withstand the effects of climate change. Moreover, households are particularly vulnerable to declines in the availability of, and/or increases in the price of, food, water, energy and transport, which reflect and sometimes amplify climate change-related impacts elsewhere (e.g. in distant water catchments, agricultural areas and electricity generation and fuel processing sites). Declining social cohesion often characterises these communities, with increased risk-taking behaviour, psychological stress and mental illness intensifying their general hardship and vulnerability.

Changes in the economy, climate or policy, driven at the national, regional or global scales, combine to impact particularly hard on the urban poor and vulnerable.[5] Working only with the formally governed parts of the city to increase climate resilience excludes the most vulnerable and exacerbates social inequality. Hence the need to focus climate compatible development efforts at the settlement scale within cities, working directly with vulnerable communities, which are often heterogeneous and fragmented in nature as compared with their rural counterparts, to upgrade their living and working conditions in ways that increase safety, security and well-being, while also increasing their participation and leverage in citywide processes of urban planning, management and investment.

Climate change impacts cannot be neatly separated from the other pressures that have a bearing on the viability of poor urban African household budgets. Planning and undertaking 'climate compatible development' in African cities must accommodate this reality, accounting for a broader set of interconnected vulnerabilities and development priorities. At the heart of this challenge lies the question of how to balance and find synergies between immediate development priorities and building the longer-term climate resilience and sustainability of African cities. This challenge is particularly pronounced in the context of slums and informal settlements within African cities, where there are high levels of contingency, fluidity and immediacy. In this regard, the African Centre for Cities (ACC) and the Climate and Development Knowledge Network (CDKN) are primarily concerned with how to support and facilitate development in African cities that addresses the realities and particular challenges associated with informality and inequality, while integrating climate change and long-term sustainability considerations.

3. Vision: Towards adaptive African cities

The core vision that ACC and CDKN are looking to develop with partners is that of the adaptive African city. Key features of such a vision include:

- Pursuing a compact spatial form with excellent connectivity for all residents, including informal residents and slum-dwellers, based on safe, affordable and low-carbon forms of mobility, while maintaining or enhancing the supporting, provisioning, regulating and cultural services provided by healthy ecosystems within and surrounding the city that have multiple benefits in terms of reducing health risks and those of physical disasters (e.g. by increasing flood regulation), providing safe spaces for recreation, education and connecting with nature.
- Accepting informality as a core part of the fabric of the city, particularly given the scale of the urbanisation challenge, and working with informal settlements and the informal economy as part of the overall city system. This requires thinking differently about how spatial planning, regulation, economic growth, infrastructure and public services can be delivered to support informal settlements, livelihood systems and local economies in an African city.
- Prioritising slum upgrading and increasing access to services based on the expansion and maintenance of public infrastructure that is resilient against a range of future environmental and economic conditions.
- Where upgrading is not possible (e.g. because of high-risk location), seeking alternatives that offer equally good, if not better, access to economic opportunities, public services and opportunities for social integration, i.e. where people feel incentivised to move and do not have to be forced.
- Investing in 'smart energy' grids and locally viable cost recovery mechanisms that increase energy access and affordability while simultaneously reducing total carbon emissions.
- Investing in a mix of low- and high-tech solutions (e.g. biogas digesters, low-flow solar water heaters, wind pumps, floating classrooms, plastics recycling, composting toilets, etc.[6]) that guarantee affordability and

universal access alongside minimum quality standards, create local jobs in production, installation and maintenance, and minimise waste through recycling water and nutrients.
- Increasing digital access across the informal as well as the formal parts of the city, attracting ICT investments and stimulating local entrepreneurship and a DIY economy.
- Facilitating massive community works initiatives to foster employment and skills development while producing tangible improvements in the quality of life in urban communities and slums, notably including activities that regenerate ecosystems and natural assets (e.g. watercourses, forests, soils, open spaces, etc.), thus shifting the perception of informal residents from that of intruders to that of entrepreneurs and service providers.
- Building open and inclusive democratic institutions (e.g. waste pickers associations, saving and investment clubs, arts collectives, drama societies, community safety forums, recycling co-operatives, etc.) that encourage active citizenship, networking across social and economic divides, and act as counterpoints to government in processes of making public investment, spatial planning and urban management decisions.
- Adopting an inclusive, participatory approach towards development; involving communities and multiple sectors in identifying priority issues, designing interventions and investing in actions to address them – not only within the administrative boundaries of the city but also involving stakeholders operating in the broader city region that are part of the same economic and environmental systems, which span municipal boundaries.

4. Purpose of the framework

The aim of this framework document is to provide guidance on how to build the resilience and sustainability of African cities by collaboratively working to reduce the vulnerability of residents, local businesses and public infrastructure and services to climate variability and change, while at the same time leveraging opportunities to reduce greenhouse gas emissions. The framework is put forward as a basis from which local practitioners, government officials, city planners, residents, researchers and donors can work together to design and undertake climate compatible development within cities. The framework is designed to provide a shared set of ideas and steps to follow when approaching the complex task of simultaneously tackling development and climate change challenges in rapidly growing African cities. It is envisaged that the framework can be further developed and refined as it is applied in various different contexts.

This framework takes as a starting point that development interventions in African cities need to address current climate conditions and patterns of settlement, economic activity, mobility and political power, while preparing for an range of altered future climate conditions and working towards a more desirable set of social, economic, political and spatial patterns that make up the future African city. Simply put, the main question this framework addresses is: How do we go about effectively addressing current development needs and priorities while in the process preparing for and creating a different (more desirable) future, particularly in light of climate change and the long term sustainability concerns that are associated with projected urban growth and expansion in Africa?

5. Structure of the document

This document presents a rationale and proposes a framework for in situ climate compatible development in slums and informal settlements in African cities that can address both short- and long-term climate adaptation and sustainability-oriented priorities at the same time. It is intended to serve as a starting point for designing and learning from practical applications of in situ climate compatible development in slums and informal settlements in African cities. The document is structured as follows:
- First, we propose a guiding set of principles for in situ climate compatible development in slums and informal settlements in African cities. These principles are not exhaustive or definitive, and represent the best state of our current understanding of the problem context, and what is required to respond to it.
- Second, we position climate compatible development in relation to African urban contexts, and the various priorities that development efforts must accommodate when seeking to intervene in slums and informal settlements across the continent.
- Third, we propose a stylised model for community-based development that is geared to support climate adaptation efforts in a broader developmental framework.
- Fourth, we conclude by proposing eight steps for applying the aforementioned stylised model to climate compatible development efforts in slums and informal settlements in African cities.

6. Principles of climate compatible in situ development in informal settlements

Based on the vision for adaptive African cities, we propose an initial set of principles to be accounted for when designing climate compatible development interventions in informal settlements in African cities. This list of principles is not exhaustive or definitive, but is intended to serve as a basis that will be refined over time as learning from actual case studies is used to revise them. Many of the principles listed below link process considerations with desired outcomes.

Climate compatible development interventions in informal settlements need to be designed to:

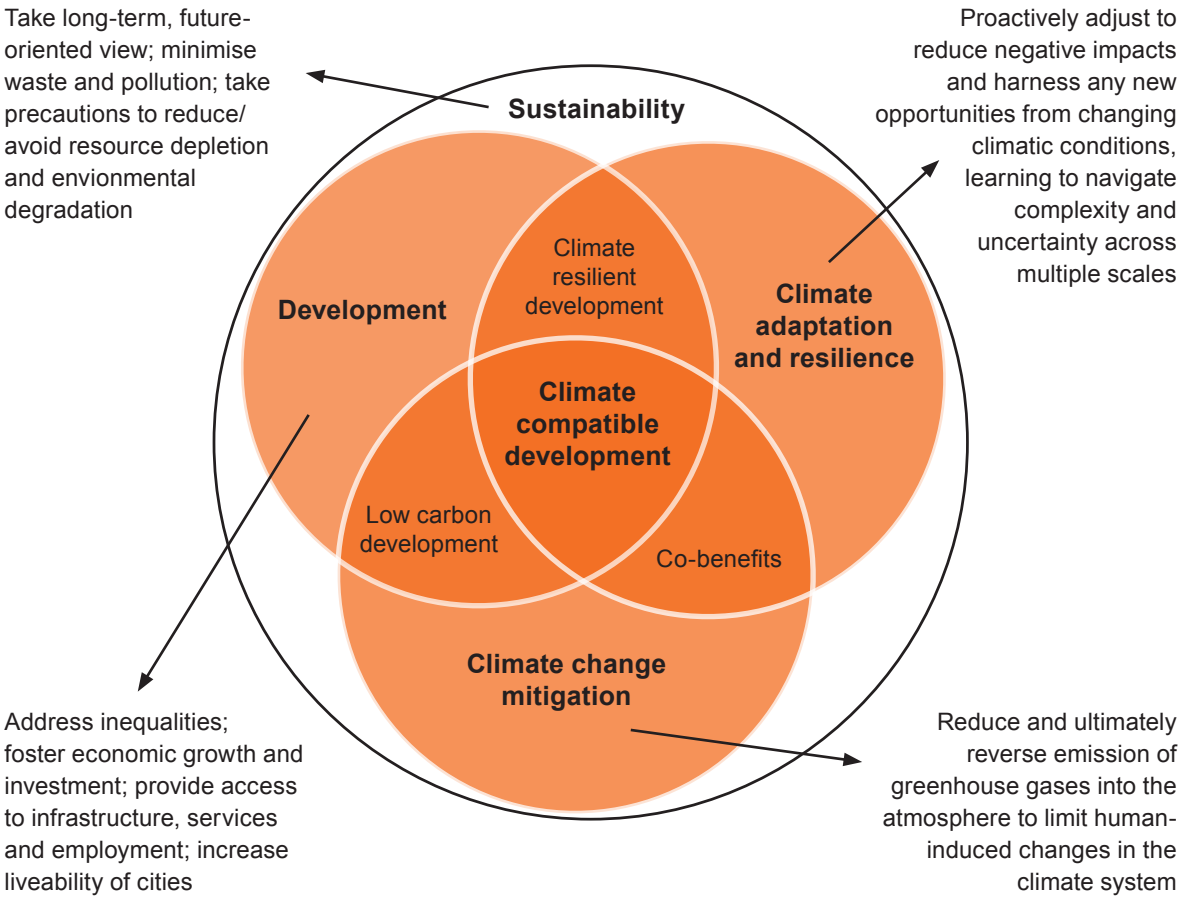
1. Achieve tangible and rapid results in improving people's safety and quality of life that incrementally generates a driving force for larger-scale, longer-term transformative change – working towards a hierarchy of improvements. For example, start with local, off-grid, safe, affordable, renewable energy technologies to generate energy for local cooking and lighting, but with a view to getting the network infrastructure in place for local generators to sell excess energy into the citywide grid.
2. Demonstrably reduce climate vulnerabilities based on careful assessment and tracking, while looking for interventions and innovations that provide both climate adaptation and mitigation benefits (i.e. emissions reductions) where possible. This might require new expertise and project partners additional to those who would otherwise be included in a traditional development project that doesn't explicitly factor in current and future changes to the climate.
3. Include affordability as a key criterion in the design of technologies and service-delivery models, not simply for installation/construction but also for ongoing maintenance and repairs, to ensure widespread access and financial sustainability. In this respect, smart, innovative design and low-tech options that meet the adaptation needs of the urban poor should be given priority. For example, look at the feasibility of distributed, locally administered, savings cooperatives to finance the maintenance of neighbourhood biogas digesters to reuse waste, reduce methane emissions and produce a local source of energy, rather than relying solely on government support programmes.
4. Match the selection of technologies and servicing models with local skills to deliver, install and maintain, strengthening existing livelihood portfolios rather than creating new competing markets. This might require initial 'up-skilling' and training of trainers, seeking to avoid ongoing reliance on outside expertise (linked to the affordability principle above) and create local employment opportunities. For example, look at registering and improving the capability of existing informal food vendors to refrigerate and store fresh food under conditions of increasing heat and humidity, while improving education about nutrition and health, rather than removing informal stalls and forcing people to travel further to large retail chains to access food.
5. Push for softer forms of regulation that support informal practices of entrepreneurship, social innovation and private service provision in slums while protecting consumers and employees by enforcing basic standards and limiting negative impacts on human health and the environment. For example, extending food safety standards to accommodate street food, having health inspectors visit street food vendors in informal settlements, discuss methods for increasing hygiene and setting a date for a return visit to measure improvements, before facing a fine. This may become increasingly important under changing climate conditions as heavier rainfall events lead to more contaminants in water and higher temperatures encourage pathogens.
6. Increase the political leverage of collectives of poor households within processes of city planning and management through mobilising, organising, assembling knowledge and networking – paying particular attention to the inclusion of and engagement with women and youth.
7. Work towards enhancing security of land tenure, fostering a sense of stability and a shared future. This can help shift the perception of (previously) informal settlements from being temporary and marginal in need of removal to that of being a legitimate, integral and valuable part of the city as a whole, as places for investment in and servicing of permanent, higher quality infrastructures that are more robust against a range of climatic conditions including heavy rains, strong winds, hotter temperatures, etc. (e.g. insulated ceilings, paved footpaths and vegetated parks).
8. Take a reflexive learning approach to factor in complexities, contingencies and uncertainties, allowing for adjustments within the project cycle. Informal settlements are highly dynamic settings and are poorly understood (i.e. minimal plans, maps, census data, etc.). Similarly, climate change is a new and emerging field of knowledge, especially on the local scale, so many local climate dynamics and feedback loops are still unclear, especially in under-researched cities. However, we know enough about both to recognise an imperative to act. So we need to act and learn iteratively, with clear goals in mind but with the flexibility to adjust our approach as we progress (i.e. building adaptive capacity), documenting and sharing new knowledge as it is produced.

We envisage that an approach to climate compatible development based on these principles services the key requirements of both poverty alleviation and sustainable development agendas. For partners working on a specific project, it could be productive to explicitly consider, negotiate and revise this list of principles in the design phase of the project, revisit it at key moments during the implementation of the project, and reflect on the list during the evaluation phase.

7. Positioning climate compatible development in the context of African cities

Figure 1 illustrates the notion of climate compatible development in the overlap between development, climate change adaptation, resilience and mitigation agendas and strategies. Climate compatible development is but one element of the broader sustainable development agenda, tending to focus specifically on the climate dimension of global environmental change to the exclusion of broader sustainability concerns. In this instance, we are specifically interested in applying the idea of climate compatible development in the context of African cities in such a manner that broader, sustainability-oriented concerns are also addressed. This is critical where African cities are concerned. Due to their large infrastructure and service-provision deficits, the decisions that are made today (i.e. urban planning, design, infrastructure and technology choices) in African cities will largely determine their ability to grow into cities with lower ecological and carbon footprint cities than Northern counterparts, and achieve higher levels of competitiveness and capacity to sustainably absorb population growth. Africa's significant infrastructure gap presents an opportunity for its cities to strategically navigate more resilient and sustainable urban development pathways and avoid getting locked in to highly resource and carbon intensive forms of growth.

Figure 1. An illustration of climate compatible development, adapted from Mitchell and Maxwell (2010)



Key features of many African cities that need to be addressed when applying the idea of climate compatible development include:

- rapid rates of urbanisation throughout the coming decades
- minimal national policy frameworks dealing with urbanisation, urban development or climate change
- high levels of informality within cities (settlements and economic activities without, or with minimal, government planning, management and regulation)
- high levels of social and economic inequality and exclusion (i.e. a small proportion of economically and politically powerful, wealthy elites amidst a large proportion of poor, economically marginalised and politically disempowered individuals, households and communities, many of whom are in their youth)
- macro-economic reliance on a narrow set of natural resources
- chronic under-investment in infrastructure
- political systems that lack transparency and accountability, harbour patronage and facilitate selective development
- vibrant and growing populations of urban residents, including a sizeable but precarious middle class, working to meet their needs and build a life in spite these challenges and the volatility they encounter.[7]

Most African cities have comparatively low greenhouse gas emissions per capita (and very low cumulative historical emissions), so the climate change mitigation agenda is not and should not be the first priority. If anything, many argue that, in the interests of global equity, developing countries can legitimately increase their emissions in the pursuit of development, albeit to a much lower peak than that of industrialised countries.[8] However, while increasing energy access and securing consistent, reliable energy supply is essential for stimulating economic growth, investing in carbon intensive solutions to achieve energy security is likely to commit African cities to higher future costs in a fossil-fuel constrained world with increasing oil-price volatility. Large African cities are likely to face international obligations and/or incentives (financial, economic and political) to curb emissions. It thus makes considerable sense for those facilitating development in African cities to look for mitigation opportunities when designing development strategies and making investments in transport, land use planning, housing, waste management and energy services. This is especially true if reduced or avoided emissions are associated with adaptation measures that reduce climate risks and/or vulnerabilities (i.e. reduce levels of exposure to climate hazards, and/or sensitivity to them). For example, providing affordable fuel-efficient cooking stoves can serve as both a climate adaptation measure, by reducing use of charcoal and wood and the denuding of watersheds, and reducing household fumes that cause respiratory problems, as well as a climate change mitigation measure by reducing household greenhouse gas emissions. Similarly, certain waste management interventions also serve both adaptation and mitigation objectives. For example, diverting organic waste from landfills to composting plants, reduces local methane emissions and produces compost to increase soil moisture retention and fertility for growing local food produce.

Aside from mitigation, there is a large need to adapt to current climate variability, as well as longer-term emerging climate change in almost all African cities. Very many residents, businesses and government-run services and infrastructure networks remain highly susceptible to damage from climatic events occurring within the current range (recurrent heat waves, cold snaps, droughts, floods, storm surges along the coast, etc.), let alone those falling outside of the current range that are more likely under future climate change scenarios. These continue to cause problems with electricity generation (especially in cities reliant on hydroelectricity), the spread of diseases and often deaths, food shortages and food price hikes, water scarcity for domestic consumption and for manufacturing and industrial processes, flooding that disrupts transport, damages household assets, public infrastructures and creates health hazards. It is therefore essential that development strategies explicitly factor in climate considerations, making households, economic sectors and whole cities more able to deal with, absorb and recover from climate extremes, as well as changing practices and designs to accommodate shifts in the climatic range, i.e. human-induced climate change that comes over and above long-term natural variations in the climate.

Because of the social, political and economic fabric of African cities, applying the idea of climate compatible development in African cities is not simply a case of ‘climate-proofing’ existing development agendas, but rather constructing new development pathways that are more inclusive and explicitly factor in climate change with other development imperatives. Ensuring that climate compatible development services longer-term sustainability objectives requires a keen focus on ensuring the adaptive capacity of urban systems in terms of the ability to self-organise and adjust in relation to externally driven changes. This invokes a clear need for an

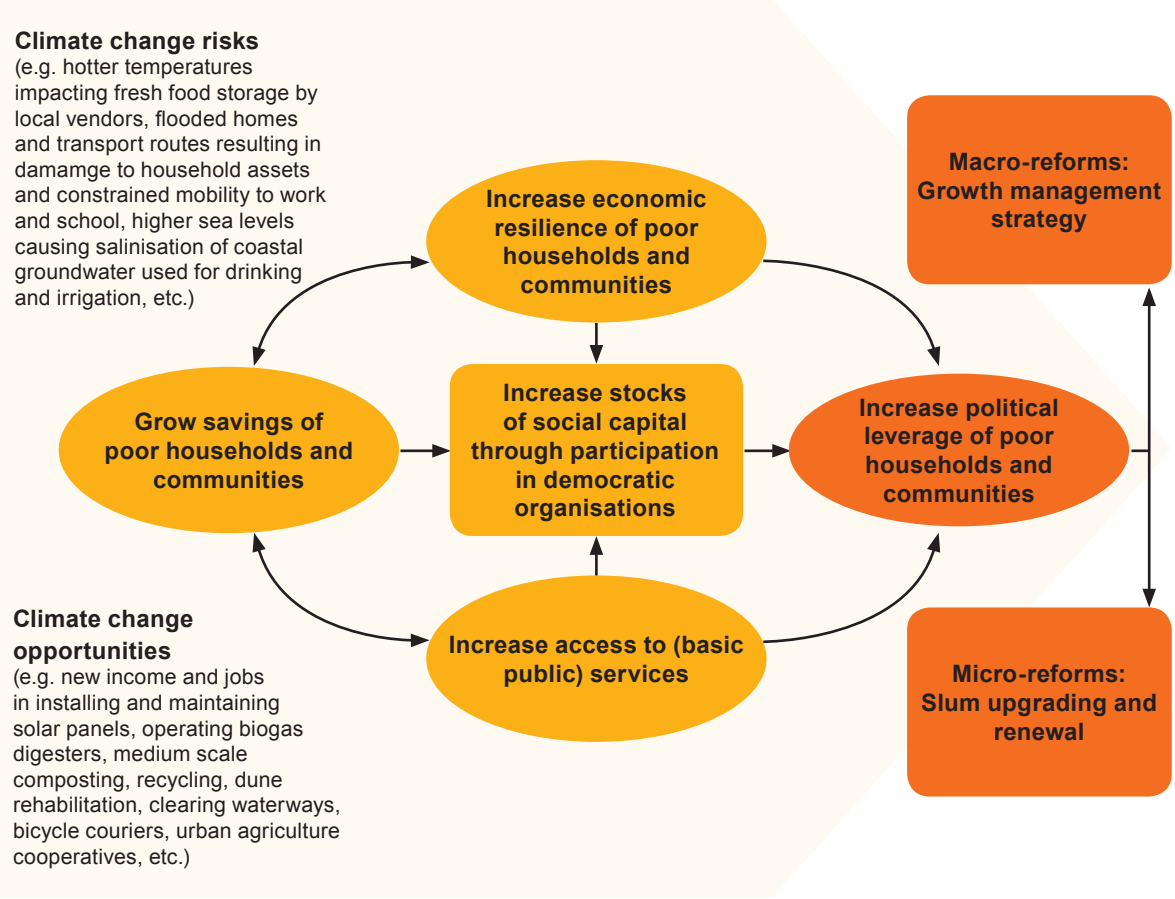
inclusive and participatory model of urban development. In the next section we propose a stylised model for inclusive, community-based development that can service climate adaptation goals at the settlement scale, while linking to larger, citywide processes of urban planning and management.

8. A stylised model for climate adaptation through community-based development

Much of the urban population growth occurring across Africa is taking place in slums and informal settlements and will continue to do so for the foreseeable future – a pattern sometimes referred to as the urbanisation of poverty. It is therefore imperative that the urban poor are central to the development agenda in Africa, ensuring that local-level interventions address concrete needs and priorities while unlocking social change that reduces current inequalities and vulnerabilities to climatic shocks and stresses.

Figure 2 illustrates a process model for linking climate compatible development interventions at the community or neighbourhood scale within informal settlements to issues of long-term sustainability and growth at the city scale. In other words it further unpacks what is at the overlapping centre of the development, climate adaptation, resilience and mitigation spheres shown in Figure 1. In the light of (1) climate risks faced at the household and neighbourhood scale (e.g. flooding, scarcity of clean, potable water, food insecurity and heat stress), especially in marginalised, under-serviced, informal settlements,

Figure 2. Stylised model of integrated and climate compatible community development (adapted from Pieterse, 2008[9])



(2) the ongoing growth of these types of settlements (in number, spatial extent and population size), and (3) the limited capacity of most local governments in African cities to fully regulate and service these areas, any model of climate compatible development in African cities will need to engage in a bottom-up, community-based yet multi-scale, systems approach to reducing climate risks and vulnerabilities.

The model of integrated community development that we propose seeks to promote *democratic, inclusive* engagement that can extend the influence of poor households and communities to enhance participation in local development strategy-making and planning, as well as to engage with broader municipal and city-scale development objectives and reforms (i.e. to engage more effectively with different tiers of governance and planning). In this respect, giving attention to the processes of facilitation that are employed in community engagement is extremely important. As far as possible, the primary goal should be to ensure that actors and participants engage on an equal footing, and that attempts to hijack the community agenda to serve the interests of a particular sector, actor or participant is avoided. This requires a core group of empowered individuals (i.e. local leaders) that want change, who are determined to achieve ownership of the change amongst a significant cohort of community-based organisations (e.g. slum-dweller movements, religious groups, traders associations and savings groups).

The model seeks to *integrate* between the different actors and sectors that influence community- and household-level vulnerability and resilience to climate stresses and shocks (e.g. impacts on food, water, energy, transport, etc.). It emphasises linking community-level and city-wide development agendas and plans to an understanding of how benefits accrue at the *household level*, and to make specific provisions for measuring and evaluating outcomes in terms of both public and private interests. Two dimensions are key in this respect: improving access to basic services including water, sanitation, health, education, housing, transport, etc. at both acceptable and affordable standards of quality, and improving access to and security of economic means including cash transfers, equipment, land, credit and employment. Both stand to be heavily impacted by changes in the climate, and it is therefore essential to explicitly consider climate risks and opportunities when selecting means for achieving such improvements. These improvements are in turn linked through growth in social capital and increasing political leverage to shape public decision-making and expenditure at the city scale and ultimately the national level too. Without these kinds of fundamental transformations in the nature of the relationships that currently underpin marginalisation, exclusion and informality, climate compatible development efforts will only be treating the symptoms of the problem and not the main drivers of vulnerability.

The accrual and measurement of progress and benefits of climate compatible development needs to occur at several different levels. Firstly, developmental progress entails improvements in the urban material form and social fabric on the community/neighbourhood scale, in terms of accessible resources, services and liveability. Secondly, in respect of direct social benefits, it is important to measure improvements at the household level, where the impacts of multiple sectors integrate to determine quality of life and the accrual of wealth or poverty (i.e. especially in terms of food, water, energy, waste, transport, etc.). This requires thinking through how community-level interventions translate into household savings and or increased resilience to climate change in combination with other environmental, economic and political changes (e.g. increasing heat stress and rising fuel prices). Undertaking this measurement and evaluation work will require partnerships between grassroots, community-based organisations, government agencies and research institutions operating in a number of sectors and disciplines (e.g. health, water, waste, sanitation, energy, transport, social services, housing, employment and more). Municipal government agencies often hold significant amounts of technical data, at a high spatial resolution, but do not have the resources for analysis. Grassroots NGOs often have access to households and people with local knowledge and language skills for conducting surveys, which government and research organisations are lacking, but may not have the expertise to design survey instruments and process the data. Universities, on the other hand, often have the researchers and analytical tools but not the data or the mandate to act on the findings. Therefore, partnerships are needed to build an evidence base for informing, tracking, evaluating and revising decisions regarding climate compatible development. Exactly what interventions and investments this type of climate compatible development entails is highly context-specific and so will vary between cities. Below we suggest a set of steps that can be undertaken to help in identifying suitable entry points and design climate compatible development interventions.

9. Eight steps for applying the model to climate compatible development in African cities

In this section, we propose eight steps that constitute a framework for applying the stylised model for climate compatible community-based development introduced in the previous section. The steps detailed in this section are as follows:

- Step 1: Develop a vision for alternative city futures and development pathways
- Step 2: Map multi-scale climate-sensitive linkages to the informal sector
- Step 3: Assess current local climate vulnerabilities with slum dwellers
- Step 4: Assess future vulnerability using climate projections
- Step 5: Identify options and leverage points and opportunities for adaptation
- Step 6: Assess mitigation co-benefits
- Step 7: Prioritise implementation of adaptation options
- Step 8: Establish mechanisms for tracking, learning and adjustment

The eight steps are meant to serve as a core set of activities around which learning can be generated and used to refine and improve the framework as learning emerges from diverse African urban contexts in which the model and framework is applied. In other words, these steps emerge from a series of deliberations amongst researchers and practitioners drawing on considerable experience, but are as yet untested in any targeted sense. ACC and CDKN intend to work with practitioners and planners operating in local government agencies and civic organisations in various African cities to apply and develop these steps further.

STEP 1: Develop a vision for alternative city futures and development pathways

The broad tenets of a vision for an adaptive African city laid out in section 3 need to be locally translated and adapted in each specific city context as part of a 'visioning' exercise, conducted with a diversity of stakeholders across socioeconomic and organisational boundaries. Local governments and/or policy think tanks could lead this visioning exercise, in close partnership with urban leadership in public, private and civil society spheres. This step involves constructing new visions of the city, re-imagining and re-articulating what the African city can and should be. This might involve selectively drawing on relevant lessons and novel ideas from elsewhere in the world, but should be firmly based in the particularities of the local context – the practices, traditions, aspirations, spatial forms, demographics and governance configurations of the city. It requires adopting an inclusive, participatory approach towards development that will underpin all the eight steps, drawing from different communities, institutions and sectors to diagnose critical conditions within human settlements and to negotiate the nature and priority of interventions. Such processes may already be underway in some cities, for example linked to the creation of City Development Strategies that the Cities Alliance and UN Habitat promote and support. If so, then efforts should be made to actively link into these existing visioning exercises to provide the strategic direction for climate compatible development in the city. While the process of engagement needs to focus on community groups as the main point of entry for conducting in situ climate compatible development, influential stakeholders in the public, private and civil society spheres acting at other scales (i.e. the city, regional, national, international, etc.) also need to be drawn into the process because of their mandate, resources, expertise and powerful role in shaping the urban system.

STEP 2: Map multi-scale climate sensitive linkages to the informal sector

When looking to support urban development in such complex and dynamic contexts, it is useful to disaggregate and map out the elements of the physical, social and economic systems (or fabric) evident at different scales. This helps in identifying existing informal practices and material entities, while keeping in sight of how various elements are interconnected within and beyond the broader city. It is within these elements that we can identify climate vulnerabilities and entry points for innovation and change, be they incremental adaptations and/or transformative changes.

Formulating a table such as Table 1 can help identify key elements that make up the city and recognise the linkages across scales, from the household and local community (in this case focusing on those in informal settlements), to the functional city region and beyond. This becomes a basis for thinking about how climate conditions impact these elements (sometimes not impacting a particular informal settlement directly or proximately but rather impacting a larger scale element and cascading through the system). Constructing such a table, or matrix, also helps in thinking through who and what will be affected by various potential interventions. By characterising the city in such a matrix it is possible to position a proposed developmental

intervention within a subset of cells, identifying those elements that are being targeted by the project. Then one can look critically at what might be necessary for scaling up or scaling out such activities through targeted linkages with those elements identified in neighbouring cells of the matrix.

While populating the cells of the table, it can be useful to think first about what is present in the city, whether formally or informally, and then what is missing or lacking, which could be a source of climate vulnerability and thereby an opportunity for innovation and change to be introduced through a planned intervention.

As with all the tables in this document, the contents is simply illustrative and by no means exhaustive. It contains examples of what might appear if such a table was constructed in a specific city. But these illustrative tables should be modified to suit the context in which they are being used, i.e. users should not feel constrained to applying them exactly as is but rather adapt the format and contents to suit the process and stakeholders involved. It is important to note that capturing the narratives around climate sensitivities and multi-scale linkages is critical, as they may prove more important than the mapping itself. That is, the narratives that emerge while constructing the table may prove more important in diagnosing priorities, deciding on where interventions may be possible, and generating ideas that specifically suit the local context.

Table 1. An example of a table for mapping out the various existing climate-sensitive elements of an informal settlement in the context of the wider city system, moving from the household scale to the neighbourhood, the city region and beyond

	Infrastructure and technology	Ecosystems (green infrastructure)	Services	Economic activities / livelihoods	Organisations (decisions, budgets)
Households and individuals within the informal sector	e.g. shack, satellite dish, bucket toilet, (illegal) electricity cable; (lacking: geysers; stoves; ceilings)	e.g. food garden (lacking: rainwater harvesting)	e.g. home-based care; carpentry	e.g. fuel wood collection; food vending; hairdressing (lacking: local crèche to keep children safe during the day)	N/A
Informal settlements/ neighbour-hoods/ communities	e.g. unregistered rental stock; market stalls; public toilets (lacking: drainage channels; paved roads)	e.g. wetland that collects flood waters; (lacking local parks for leisure and recreation, street trees for shade)	e.g. food retail; water sellers; taxis; internet cafes (lacking: storm water drainage maintenance)	e.g. food stalls; money lending (lacking: waste collection, sorting and sale for reuse and recycling)	e.g. youth club; community safety forum; (lacking: savings groups)
City administrative boundaries	e.g. road network; sewage system (lacking: storm water drainage within informal areas, land tenure security)	e.g. forest stand used for fuel wood; public green open spaces informally used for grazing livestock	e.g. primary health care; policing (lacking: social housing; waste management; universal access to water, sanitation and electricity)	e.g. employment in private security (lacking: skills accreditation; ecosystem restoration and conservation)	e.g. civic alliance; political parties; local government
Functional city region	e.g. inter-basin water transfer schemes (lacking: commuter rail network)	e.g. coastal dune cordon that helps buffer storm surges being mined for sand	e.g. land surveying; property conveyance	e.g. commercial chicken farming	e.g. water users association (lacking: coordination between municipalities)
National to regional (as impacting informal settlements within the city)	e.g. national electricity grid (lacking: technology for local electricity producers to feed into the grid)	e.g. trans-boundary rivers	e.g. tertiary education (lacking: subsidies for low-cost green technologies on government housing stock)	e.g. mining; shipping; forestry; agriculture	e.g. labour unions; conservation NGOs; parliament

It is the narratives that facilitate the participatory engagement to a large degree; in a sense, Table 1 is intended to serve as a tool to facilitate the process of engagement. By exposing linkages from the household to neighbourhood, neighbourhood to city, city to region and higher levels (i.e. national, regional and global) to a wider audience, elements of how climate change effects manifest themselves at different levels can be contemplated alongside local impacts and priorities.

STEP 3: Assess current local climate vulnerabilities with slum dwellers

Because we are focusing on *climate* compatible development, it is necessary to give explicit consideration to climate vulnerabilities and potential opportunities when planning interventions. Undertaking Step 2 and 3 yields an account of current vulnerabilities of a particular settlement to climate variability and change impacts (e.g. due to lack of infrastructure, conditions of poverty, etc.). Thereafter, in Step 4, expert and local knowledge is combined to identify how these climate vulnerabilities are projected to change in the medium to long-term future (i.e. *climate* rather than *weather*). One of the critical aspects of climate compatible development is planning in light of an altered set of future conditions and not simply based on experiences in the past.

Slums and informal settlements are often positioned in particularly high-risk locations within the city, on marginal land set aside by city planners and formal property developers. In addition, they lack the requisite infrastructures, services and financial resources to cope with and ultimately adapt to climate change effects, such as gradual shifts in temperature, rainfall, wind intensity and direction, sea levels, coastal erosion, groundwater salinity, storm-water runoff, etc. and to changes in the frequency and/or severity of extreme events, such as fires, floods, heat waves, storm surges, etc. It is necessary to think about climate vulnerability in terms of both *exposure* to climatic hazards and *sensitivity* to the impacts of such exposure, as a basis for finding ways to adapt infrastructures, services and livelihood practices to reduce the impacts of climatic hazards.

This requires identifying the climatic conditions that currently create hazardous situations in informal settlements (what damages homes, possessions, pathways and roads; disrupts services; creates health threats; reduces mobility; curtails economic activities; depletes household budgets; etc.). As well as identifying who or what are most susceptible to the impacts of such conditions, be they sudden-onset extreme events or gradual, creeping pressures. Creating a simple matrix such as the one below can help think through the various climate dimensions affecting the urban area being targeted for development.

Another useful tool for understanding current climate vulnerability is to review recent records of extreme-weather events and impacts, such as newspaper articles or photographs of flood events, or engage with key individuals or organisations with memories and records of recent extreme weather, such as disaster management and humanitarian agencies. This may provide further information about the nature of climate hazards within a particular settlement, helping to populate and refine Tables 1 and 2 further.

Having adapted the rows (exposure units) and columns (climate hazards) to suit the context, what is particularly important in the process of constructing such a table for a specific location or community is why each of the scores are given. In other words, exploring the reasons *why* some constituents are more or less exposed to climate hazards and more or less sensitive to being impacted. This could be related to geographic factors (e.g. how close they are to the coast, how steep a slope they are positioned on) or socioeconomic factors (e.g. the health and employment status of the household members, the safety nets available such as savings or insurance, etc.). For example, people with pre-existing health conditions will be exposed to the same extent as their neighbours to hot temperature conditions (assuming they live in similar housing structures in terms of materials, design, etc.) but they are likely to be more sensitive because the physical heat stress and dehydration will add to and compound their prior symptoms, like high blood pressure or fever. Similarly, people in ill health are more vulnerable to flooding because they have less physical strength to undertake coping mechanisms (like bailing water, raising furniture on bricks, etc.) and may be reliant on receiving medication from clinics, which may also be disrupted by flooding or the routes between their home and the clinic might become impassable due to flooded walkways and roads. In such a case, working with government health facilities and health NGOs to support and strengthen a local home-based care network might be an effective adaptation or climate compatible development intervention. The value of going through the process to construct a table such as the one above is both to prioritise and target

locally relevant and context specific interventions together with key stakeholders, and to explicitly capture the rationale for making your selection that can then be shown to potential funders and collaborators.

This matrix captures various climate impacts one by one, i.e. the impact of one climate hazard on one livelihood activity, service or piece of infrastructure, whereas in reality these often have knock-on effects between the cells, magnifying the resulting impacts, e.g. high winds blow sandy top soil and solid waste into drainage channels that clog and then result in more widespread flooding when heavy rains come. It is therefore important to capture the key narratives linking specific climate impacts and vulnerabilities that emerge while populating the table, i.e. capturing how local vulnerabilities compound in the face of climate change. In this respect, the mapping and scoring outlined in Table 2 are intended to serve as a tool for understanding relative priority areas, and structuring the discussion in a participatory process. It may well be useful to revisit Table 2 after completing Step 4, to discuss how these vulnerabilities are likely to change over time having heard about the climate projections for the area. This is important in ensuring that the development interventions we promote and support in the near-term contribute to reducing people's vulnerability over the longer-term and do not lead to 'mal-adaptation', i.e. an intervention that increases climate risks in the future.

STEP 4: Consider future vulnerability using climate projections

It is important to bring together scientific and anecdotal evidence of how these climate exposures and sensitivities have been changing and are expected to change into the future. Table 3 attempts to assess the medium to long-term vulnerabilities of a particular settlement, given the current vulnerabilities identified in Tables 1 and 2.

Such a table combines local and scientific knowledge. Combining qualitative information from interviews, focus groups, etc. with quantitative information from spatial and time-series analysis provides a robust basis for planning and assessing climate compatible development interventions. Linking such knowledge sets often requires collaboration between organisations with different expertise, e.g. university-based research units

Table 2. Example of a table constructed to explore local current climate vulnerabilities in a given settlement

What is exposed?	Climate hazards				
	Extreme hot temperature	Heavy rains	Late onset rains	High winds	Storm surges
Food vendors	3	3	2	2	0
Commuters reliant on public transport	2	3	0	1	0
Water resources	3	3	2	0	2
Temporary housing structures	2	3	0	3	2
Child-headed households	2	3	1	3	2
People with high blood pressure	3	3	1	3	2
Drainage channels	1	3	1	2	2

Impact score
3 = high exposure and high sensitivity, serious negative effects, very vulnerable
2 = low exposure but high sensitivity, moderate negative effects, medium vulnerability
1 = any level of exposure but low sensitivity, marginal negative effects, low vulnerability
0 = no exposure and/or no sensitivity, no negative effect (could be neutral or positive effect)

and NGOs operating locally. Step 4 is where climate scientists become involved as one of the stakeholders in framing the developmental challenges that may face a particular informal settlement or slum in the medium and long-term. Scientific experts can share their knowledge and understanding of climate change model projections within the assessment process, with community leaders, government officials, business operators and others affected at the local level.

It is important to recognise that not all cities will have sufficient historical climate data, local climate scientists and appropriately downscaled climate projections to make this exercise possible.[10] There may be consensus on the main trends at city or regional level (e.g. increasing water scarcity), but there may be constraints in applying these trends at the individual settlement level (e.g. the settlement may be located within a marginal marshy area where a periodic excess of water appears to be the problem). This is why linking the city-level science (columns B–D in Table 3) with local settlement-level insights (column A) and facilitating dialogue between researchers and residents, especially those that have been resident long-term, is important. Through this combining of knowledge one can arrive at a more comprehensive picture of the local climate trends and changing vulnerabilities within a particular settlement.

When generating the content of Table 3 in participatory processes with direct community engagement, it is important to capture the narratives describing the vulnerabilities of households, social groupings and the community at large to climate change effects. In particular, it is important to capture how linkages between climate and other environmental, economic, social and spatial conditions impact on residents and local businesses (e.g. when heavy rains flood the settlement people have to use alternative routes that are not as safe so muggings and assaults go up). Together, Table 2 and 3 can be used to design and assess interventions that can simultaneously address both immediate needs and longer-term priorities of building systemic resilience and sustainability. For example, poor drainage systems may render a settlement particularly vulnerable to flooding when heavy precipitation events take place. If climate models project that these events are likely to become more intense and/or more frequent, it would be wise to ensure that whatever actions are taken in the short term to address drainage problems and curb flooding adequately

Table 3. Drawing together evidence on local trends in climate vulnerability

CLIMATE HAZARD	A: Observed trends in climate vulnerability (including who or what is being most impacted)	B: Projected future trends in climate vulnerability	C: Level of confidence/ uncertainty	D: Evidence base
Sea storm surges	Sea surges in winter are resulting in increasing damages to fishing settlements along the coast, coastal road and drainage infrastructure, as well as key tourist sites that are large employers	Projections of sea level rise indicate likely greater reach inland of sea surges, factoring in population growth projections this increases the number of people and assets exposed substantially (Nicholls, 2010)	High confidence in rising sea levels but uncertainty in size and timing of increase and potential combination with intensified storm systems	Sea-level rise and coastal risk study commissioned by the World Bank; interview data collected with residents in X coastal informal settlement and business owners operating around the tourist resort Y
Heavy rains	Residents of settlements A and B are reporting stronger rains in recent years that are washing away more sections of the road connecting to the central city. Those most affected are those working as vendors and in the service and manufacturing industries	Scaled down climate projections show a likely increase in the number of days exceeding 20 mm of rainfall	Low confidence in the projections as some models are showing a decline while others are indicating an increase in extreme wet days	Research report commissioned by Oxfam surveying 300 residents and climate projections accessed from http://cip.csag.uct.ac.za
Extreme heat				

account in their design and financing model for incremental upgrading that expands the capacity of the system (and the potential for storm-water reuse) over time. As outlined earlier in this document (see Figure 1), tying short-term needs to longer-term goals is critical for achieving sustainability and creating a resilient urban system.

STEP 5: Identify options and leverage points and opportunities for adaptation

Having identified the sources of current and future climate vulnerability, the next step necessitates looking for different options for intervening – introducing a new technology (e.g. vertical food gardens, biogas digesters, communal refrigeration facilities for food vendors), modifying an existing practice (e.g. building on raised foundations, expanding rainwater harvesting storage capacity), connecting up two previously separate services (e.g. public transport and environmental education, home-based care and conducting enumeration surveys), or rehabilitating an environmental/ecosystem service (e.g. planting mangroves for coastal protection, removing solid waste and invasive species from local waterways). In this step it is important to bring together stakeholders with different expertise and needs in innovative design processes. As with earlier steps, facilitation and conflict-management skills are key to success. Identifying what levels of intervention are critical to meeting particular local development needs is also important. In this respect, reflecting on the mappings and scorings undertaken in the previous steps (i.e. as outlined in Tables 1, 2 and 3) – and the key narratives that emerged from participatory processes – provides valuable reference material for contemplation and discussion of multi-scale effects, and in turn what multi-level governance and development responses are necessary. The range of options identified in this step need to be aligned with the overall vision and principles for moving towards adaptive African cities, outlined in sections three and six above, to avoid falling back into simply rolling out business-as-usual measures because they are familiar rather than because they are best suited to the local context and evolving nature of the problem.

STEP 6: Assess mitigation co-benefits

As shown in the three overlapping rings of Figure 1, climate compatible development involves looking for interventions that give rise to both adaptation and mitigation benefits where possible. While adaptation is the priority in most African cities, screening options for mitigation co-benefits can open up the possibility of leveraging additional financing mechanisms and help in building widespread energy access and security, as a critical basis for carbon-efficient, sustainable and inclusive futures. This requires working with organisations and agencies that have expertise in greenhouse gas accounting methods and procedures, as well as the knowledge of how to successfully access Clean Development Mechanism (CDM) funding sources and/or voluntary carbon markets. Other mitigation incentives (e.g. for technology uptake and/or service provision options that have mitigation co-benefits), from city, national, regional and global organisations may also prove valuable in constructing robust financial support for programmes and projects.

STEP 7: Prioritise implementation of adaptation options

The most difficult step is often selecting between various options that have been suggested through a participatory process to meet developmental needs and reduce climate vulnerability; selecting which are more popular, feasible and viable and sequencing those that can be implemented in the near-term and those that first require certain conditions to change before implementation is viable. Various tools exist for making such prioritisations, some on the more political, value-based end of the spectrum such as voting or expert judgement and others on the more technical, rationalist end of the spectrum, such as cost benefit analysis, cost effectiveness analysis, feasibility studies, etc. Here the selection of tools and methods to be used have significant influence over the outcomes of the process, and can more or less inclusive and empowering. It is important to look back at the development goals and pathways laid out in Step 1, when making these choices. ‘Multi-criteria analysis’ is becoming a popular and much promoted decision-support tool for selecting between adaptation or climate compatible development options, which blends both technical and value-based aspects of decision-making. This involves rating options against a set of criteria, weighting the criteria according to relative importance, and then comparing the results to see which options score more highly and will be prioritised for implementation.[11] This method does not eliminate questions of power, influence and participation in terms of who selects the criteria, does the rating and the weighting, but it does at least make the process more explicit. Table 4 provides an example of the kind of criteria that can be applied in such an assessment, relating back to the principles laid out in section 6 above.

Table 4. Potential criteria for assessing options (adapted from Bizikova L., T. Neale and I. Burton, 2008[12])

Category	Criteria	Score 1 (low)	Score 2 (medium)	Score 3 (high)
Sustainability: Social, Economic, Environmental	Mitigation co-benefits	Result in increased greenhouse gas emissions	Would not affect greenhouse gas emissions	Would reduce greenhouse gas emissions
	Environmental impacts	Result in net environmental Costs	Result in no net loss of habitat or ecosystem services	Result in net environmental benefits
	Equity	Benefits to few people	Benefits to many people	Significant benefits to many people
	Employment	No new work opportunities created locally	Few, or only temporary, jobs created locally	Numerous and/or long-term work opportunities created
	Land tenure	Relies on existing land tenure security	Works within informal land arrangements	Contributes to the formalisation of land tenure
	Replicability	Small-scale, context specific, resource-intensive	Lends to replication but requires external support	Builds skills and resources for self-replication
Effectiveness	Robustness	Effective for a narrow range of plausible future scenarios	Effective across many plausible future scenarios	Effective across a wide range of plausible future scenarios
	Reliability	This measure is untested	Experimental but has expert support	The effectiveness of this measure is proven
Risk and Uncertainty	Urgency	Risks are likely to occur in the longer term	Impacts are beginning to occur, or are likely to occur in the near- to mid-term	Impacts are already occurring
	Degree of risk or impact	Future risks are minor and reversible	Future risks are moderate and reversible	Future risks are potentially catastrophic or irreversible
	Precautionary	The risk is generally understood	Some uncertainty exists	The risk is not well understood
Opportunity	Ancillary benefits	This measure will contribute little or not at all to other goals for the community	This measure will contribute somewhat to other goals for the community	This measure will contribute significantly to other goals for the community
	No-regrets option	This measure will have little or no benefit if climate change impacts do not occur	This measure will have some benefits regardless of actual climate change impacts	This measure will result in significant benefits regardless of actual climate change impacts
	Window of opportunity	There is no window of opportunity currently	A window of opportunity could be created	A window of opportunity exists to implement
Implementation	Public acceptability	Likely to face public opposition	Not likely to receive much public attention	Likely to receive public support
	Implementation cost	Cost of implementation is high relative to cost of inaction	Cost of implementation is moderate relative to cost of inaction	Cost of implementation is low relative to cost of inaction
	Operating and maintenance cost	Cost of operation and maintenance is high	Cost of operation and maintenance is moderate	Cost of operation and maintenance is low
	Funding sources	External funding sources are required but have not been identified	External funding sources are required and likely to be secured	Funding is available
	Capacity (info, technical, staff, resources)	Current capacity is insufficient and gaps cannot be easily addressed	Gaps exist in one or more areas but can be addressed	Current capacity is sufficient
	Institutional	Implementation requires coordination with, or action by, other jurisdictions	Implementation requires external approval	Implementation is within local control

STEP 8: Establish mechanisms for tracking, learning and adjustment

Once the selection is made then the implementation phase can start in earnest, hopefully with all stakeholders now on board. Of course this is the most difficult step, taking time, commitment and flexibility; the step that cannot be prescribed in a framework. No plan is ever perfect, especially when intervening in such complex systems with unforeseen feedback loops and involving diverse stakeholders with conflicting viewpoints, priorities and approaches. Adjustments will therefore be required as stumbling blocks emerge and new information becomes available. In order to prepare for and manage these difficulties, mechanisms for tracking implementation and forums for evaluating progress and outcomes need to be established. Monitoring, analysis and feedback needs to be conducted in a culture of openness, experimentation and learning, so that continual improvement of the community development model results from these efforts over time.

Next steps

This proposed model and framework for climate compatible development in African cities is based on a review of relevant literature, stakeholder interviews and site visits in Accra (Ghana), Addis Ababa (Ethiopia), and Kampala (Uganda), and two expert workshops hosted in Cape Town (South Africa).[13] It reflects the current state of our collective thinking and will form a basis for ongoing collaboration and learning between CDKN, ACC and our counterparts in various African cities. We are interested in how this framework might be applied and adapted in designing, planning, tracking, revising and scaling up climate compatible development interventions. We invite readers to share their views, experiences and examples to help shape this thinking as it develops.

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Endnotes

1 Climate compatible development (CCD) is low carbon, climate resilient development. It is a 'development first' approach that 'minimises the harm caused by climate impacts, while maximising the many human development opportunities presented by a low emissions, more resilient, future. (Mitchell and Maxwell, 2010). http://cdkn.org/resource/defining-climate-compatible-development-3/.

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6 For more examples and details visit the Practical Action website that provides resources and success stories focused on small-scale appropriate technologies: http://practicalaction.org/browse-and-download-answers.

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10 For supporting guidance on how to address some of these shortcomings by accessing and applying historical climate data and downscaled climate projections see: http://weadapt.org/knowledge-base/using-climate-information/guide-to-using-climate-information.

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13 For full details refer to the background paper and two workshop reports available from Lisa McNamara: lisa.mcnamara@cdkn.org.

About CDKN

The Climate and Development Knowledge Network (CDKN) supports decision-makers in developing countries in designing and delivering climate compatible development. It does this by combining research, advisory services and knowledge-sharing in support of locally owned and managed policy processes. CDKN works in partnership with decision-makers in the public, private and non-governmental sectors nationally, regionally and globally. CDKN is managed by an alliance of organisations: PricewaterhouseCoopers (PwC), Overseas Development Institute (ODI), Fundación Futuro Latinoamericano, SouthSouthNorth, LEAD International and LEAD Pakistan. www.cdkn.org

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The African Centre for Cities (ACC) is as an interdisciplinary research body at the University of Cape Town. Its mission is to conduct collaborative research and contribute to imaginative policy discourses and practices. The aim is to promote vibrant, just and sustainable cities. The ACC's key values are social justice, radical democracy, cosmopolitanism and ecological integrity.

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