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15 Climate Change Adaptation Through Urban Planning: a Proposed Approach for Dar Es Salaam, Tanzania

Abstract: The need for climate change adaptation is increasingly influencing the discourse about spatial development strategies throughout the world. Nevertheless, several gaps still exist in our understanding of the spatial dimensions of climate change vulnerability and how to incorporate them into planning practices. Firstly, attention has been mostly focused on how to adjust physical assets to climate change, while the question of how to strengthen local adaptive capacity remains rather neglected. Secondly, while many cities have institutionalized climate change, integration of adaptation considerations into existing urban planning and governance systems is still lacking. As a result, not only do the plans and programs in place for urban development and environmental management often fail to address adaptation needs, they may even jeopardize current adaptive capacity. The latter has particularly serious consequences for Sub-Saharan cities, where people's capacity for autonomous adaptation is a crucial resource, given the limited capacity of local government institutions to fulfill their responsibilities. This chapter proposes a methodology for mainstreaming adaptation into existing planning documents, developed specifically for the city of Dar es Salaam, Tanzania. After providing a brief review of approaches and challenges in adaptation mainstreaming, the main features of the proposed methodology and preliminary results of its application are presented. Lessons learned from the experience are examined in the conclusions.

Keywords: Adaptation, Mainstreaming, Sub-Saharan Africa

15.1 Introduction

The need for climate change adaptation is increasingly influencing the discourse about spatial development strategies throughout the world (Davoudi *et al.* 2009). Nevertheless, several gaps still exist in our understanding of the spatial dimensions of vulnerability to climate change induced impacts and how to incorporate them into planning practices.

Firstly, attention has been mostly focused on how to adjust physical assets to climate change, encompassing issues related to climate proofing, robustness, and

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resilience of the built environment and infrastructure. Meanwhile, the question of how to strengthen the adaptive capacity of local communities and authorities remains rather neglected by urban planners and policy makers. It should be noted that the latter requires a change in the way vulnerability is interpreted: from a linear result of climate change impacts on an exposure unit (outcome vulnerability), to a dynamic state resulting from the interaction between climate change and contextual conditions associated with an exposure unit (contextual vulnerability) (O'Brien *et al.* 2007). Such a change broadens the spectrum of adaptation action to include the structural inequalities of the context in order to change vulnerability circumstances, thus paving the way for “transformational adaptation” (IPCC 2013a:1).

Secondly, while many cities have institutionalized climate change strategies by establishing a dedicated climate unit either within an existing department or as a separate cross-cutting office (Anguelovski and Carmin 2011) and preparing a local adaptation plan for action (Carmin *et al.* 2012a, 2012b), integration of adaptation considerations into existing urban planning and governance systems is still lacking or immature. In fact, most adaptation mainstreaming research and practices have focused on development policy at the national level (Klein 2002; Huq *et al.* 2003; Agrawala 2005; Persson and Klein 2008). Although this provides a valuable theoretical and practical basis for advancing at the sectoral and local level, a considerable amount of work is still needed to operationalize the concept of adaptation in urban planning, thus enabling the identification of context specific adaptation options.

As a result, not only do the plans and programs in place for urban development and environmental management often fail to address adaptation needs, they may even jeopardize current adaptive capacity. The latter is especially threatening in the Sub-Saharan context, where people’s capacity to adapt to change in their living environment is often a necessary substitute for insufficient institutional capacity to provide adequate infrastructure and services to a rapidly growing population (Ricci 2011, 2014).

This chapter proposes a methodology for mainstreaming adaptation into existing urban development and environmental management plans of cities in Sub-Saharan Africa.

According to Friedmann (2005), urban planning in Africa faces four major challenges: an average urban population growth of at least 5% annually; implosion of the informal economy; local government’s financial inability to adequately service the population; and allocation of the majority of the land without regard for planning regulations. Climate change is expected to exacerbate existing problems, as it threatens the natural resources upon which livelihoods of the majority depend, and is likely to give further impetus to the vicious circle linking environmental degradation to urban sprawl (Macchi *et al.* 2013). In light of recent climate change predictions, there is an increasingly urgent need to improve sustainable human settlement and infrastructure development in the least developed countries (Satterthwaite *et al.* 2007), while reframing urban policy and governance in an adaptation perspective.

However, the question arises as to whether mainstreaming adaptation into existing plans can contribute to this improvement, when such plans are usually in default of implementation due to an unsuitable “culture of planning” (Friedmann 2005). The present work adopts an incremental perspective, emphasizing the importance of context in identifying viable ways to change the culture of planning in Sub-Saharan Africa. This perspective associates the need for adaptation to climate change with a shift in how the Sub-Saharan city is conceptualized. Adaptation mainstreaming is seen as a means to improve the effectiveness of existing plans and programs while bringing the autonomous adaptive capacity of people to the center stage of urban planning in Sub-Saharan Africa (Macchi 2014).

The city of Dar es Salaam was chosen as a case study for developing mainstreaming methodology⁴¹. It is the most populous city in the country (4.4 million inhabitants in 2012) and the main engine of the national economy: 16.9% of national GDP in 2001–2012; +20.9% of regional GDP in 2011–2012 against a national increase of +17.9% (URT 2013). In the last decade it has expanded far beyond any planning projections: +75% of population in 2002–2012; +76% of continuously built-up areas, and +192% of discontinuously built-up areas in 2002–2011 (Congedo and Munafò 2014), and today a new policy strategy for urban development and environment management is under consultation (Halloran and Magid 2013; Dodi Moss *et al.* 2013). Due to over-pumping of groundwater in the coastal plain and subsequent intrusion of seawater in the shallow aquifer, people living in that area are already experiencing limited access to fresh water, and the entire coastal socio-ecological system is at risk (Faldi and Rossi 2014; see Chap. Sappa). Although the lack of long term meteorological data and the inherent complexity of climate dynamics prevent accurate downscaling of climate change projections to tropical East Africa, available observations show an increase in temperature and a decrease in rainfall (Rugai and Kassenga 2014), which will amplify the need for water resource conservation and promotion of alternatives to the coastal aquifer.

A brief review of approaches and challenges in adaptation mainstreaming are provided below. The main features of the proposed methodology and a few preliminary results from its application are then presented, with a focus on the planning provisions for peri-urban areas in the Dar es Salaam 2012–2032 Draft Master Plan (Dodi Moss *et al.* 2013). Lessons learned from the experience are examined in the conclusions.

⁴¹ The study has been conducted within the framework of the EU funded project “Adaptation to Climate Change in Coastal Dar es Salaam”, which aims to improve the effectiveness of local authorities in supporting the autonomous efforts of coastal peri-urban populations to adapt to climate change. For further details see www.planning4adaptation.eu

15.2 Understanding Adaptation Mainstreaming

In policy literature, the term “mainstreaming” is often used interchangeably with “integration” and “incorporation” to designate a strategy for dealing with cross-cutting issues, like adaptation to climate change. According to Working Group II of the Intergovernmental Panel on Climate Change (IPCC WG2), which focuses specifically on climate change impacts, adaptation, and vulnerability, there is robust evidence that “integration of adaptation into planning and decision-making can promote synergies with development and reduce the possibility of maladaptive actions” (IPCC 2013b: 31). In the context of this chapter, adaptation mainstreaming is understood as the process of systematically integrating adaptation needs into existing urban planning documents, while avoiding maladaptation.

Before examining the arguments for and against the adoption of a mainstreaming approach to climate change adaptation, it is worth mentioning three key notions as defined by the WP2 in the IPCC Fifth Assessment Report: adaptation, maladaptation, and adaptive capacity. Adaptation is “the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climate and its effects” (IPCC 2013b: 1). Maladaptive actions (or maladaptation) are “actions that may lead to increased risk of adverse climate-related outcomes, increased vulnerability to climate change, or diminished welfare, now or in the future” (*ibid.*: 18). Adaptive capacity is “the ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences” (*ibid.*: 2).

15.2.1 Mainstreaming Versus Stand-alone Adaptation

Although “there are few assessments of adaptation delivery and effectiveness” (IPCC 2013c: 22), cross-sectoral integrated approaches are viewed as more effective than stand-alone efforts. This is mainly due to the multi-dimensionality and multiscale-ity of the notion of vulnerability when applied to socio-ecological systems, as well as to the uncertainty of local vulnerability trajectories, which are highly influenced by the combined effects of climate change and socio-economic scenarios. Such considerations are particularly relevant to the research presented here, which seeks to reduce vulnerability by developing the autonomous adaptive capacity of private individuals, as opposed to improving the climate proofing of public decision-making and spending.

Adaptation as a self-standing action usually consists of measures that address a single policy sector in a mono-disciplinary way. This involves a limited number of actors in a linear decisional process where inputs and outputs are clearly defined ex-ante, and favors solutions that can be repeated in other locations, are achievable in the short term, and use standardized design and plan-driven (conformative) imple-

mentation methods. By contrast, adaptation mainstreaming has the potential for multi-sectoral action, and requires the involvement of all levels of governance as well as a broader range of stakeholders in decision-making. It mobilizes different knowledge and competences in an iterative and open-ended process, favors context specific solutions that are achievable in the medium-long term, and uses experimental design and target-driven (performative) implementation methods (Macchi and Ricci 2014).

Given its characteristics, the stand-alone strategy is undoubtedly easier to apply than the mainstreaming strategy, particularly in terms of planning, acquisition of financial resources and other necessary means, decision-making, implementation, and evaluation of results. In addition, it provides the institutions involved with shared, short-term goals that foster motivation to effect change, something that is missing in the mainstreaming approach and may end up compromising its main value-added, i.e. its transformative potential.

However, the efficacy of a stand-alone and sector-specific action in reducing vulnerability in the medium-long term is far from guaranteed in rapidly changing contexts, like those in Sub-Saharan cities, or where highly uncertain risks are involved. Conversely, by ensuring coherence and seeking synergies across policy domains and institutional levels, the mainstreaming strategy allows the plurality of interconnected, multisectoral factors that shape vulnerability (Adger *et al.* 2007) to be addressed in an integrated way and with a long-term perspective.

Finally, according to the literature, integrating adaptation into development and sectoral decision-making in sectors affected by climate risks also facilitates the leverage of the much larger financial flows than would be available to finance adaptation separately (Agrawala 2005). In general, integrating adaptation allows for more sustainable, efficient, and effective use of resources (Persson and Klein 2008).

The mainstreaming methodology and exercise reported in this chapter are intended as a first step towards the full development of an adaptation mainstreaming strategy involving all sectors and levels of government in Dar es Salaam. Rather than beginning with a detailed reconstruction of decision-making among local authorities, a few provisions of existing urban development and environmental management plans and programs are used as entry points for the mainstreaming process. The reasons for this are twofold. Firstly, the research team sought to address issues of direct concern to local officers involved in the project in order to stimulate their interest and increase the likelihood that change would be implemented. Secondly, regarding requests for funding, the officers involved expected help in identifying which measures already in place would qualify as adaptation with little or no change. The funding issue is a bottleneck for Dar es Salaam's local authorities when implementing planning decisions, as their budget depends on national transfers which are limited and uncertain (Tanzania is classified as a least developed country, with a per capita GDP of USD 652 in 2012). As a result, a hybrid approach was adopted where each sectorial planning provision was considered separately, but with a view to advancing adaptation mainstreaming.

15.2.2 Focusing on Adaptive Capacity

This work assumes that the purpose of adaptation is to strengthen people's capacity to autonomously adapt to a changing environment rather than to secure the physical environment through improved infrastructure and measures for impact mitigation⁴². The specific focus is on populations living in peri-urban areas within the coastal plain and their capacity to adjust livelihood strategies and practices in response to actual or expected variations in living conditions. The “adaptive capacity” concept is central to this approach and deserves some further clarification.

Firstly, the relation of adaptive capacity to vulnerability should be examined. Depending on the author, adaptive capacity may be seen as being one component of overall vulnerability (Füssel and Klein 2006) or as a separate, though related, factor, as is usually the case in disaster risk management studies. The recent IPCC WP2 contribution to the Fifth Assessment Report provides useful insight into this subject by distinguishing two types of vulnerability: contextual or starting-point vulnerability and outcome or end-point vulnerability. The former is defined as “a present inability to cope with external pressures or changes, such as changing climate conditions” and “a characteristic of social and ecological systems generated by multiple factors and processes” (IPCC 2013a: 8). The latter describes vulnerability levels after adaptation has taken place (*ibid.*: 19).

Given the scope of this work, the notion of contextual vulnerability has been adopted. Considerable time and energy was spent gathering people's views on environmental changes of concern and current strategies adopted to cope or adapt to them, as well as to outline the main factors and conditions influencing households' in the peri-urban (Ricci 2011, 2014).

Drawing on Amartya Sen's capability approach, adaptive capacity can be defined as the sum of all the strengths, attributes, and resources available to a society (institutions, local groups, individuals, etc.) that could play a positive role in facilitating adjustment to expected climate change and its effects. Building this kind of capacity is acknowledged as “a means, among other objectives, to shift the analytical balance from the negative aspects of vulnerability to the positive actions by people” and “fundamental to imagining and designing a conceptual shift favoring disaster risk reduction and adaptation to climate change” (IPCC 2012: 33). In other words, it encourages adoption of a planning attitude, as capacity building requires “a clear image of the

⁴² A full justification of this choice is given in Macchi (2014), including scarce financial resources, a rapidly changing environment, the high uncertainty of climate change impacts, and recognition of the peri-urban as the main modality of urban development in “the century of urbanization”. In this context, the concept of adaptive capacity is seen as a heuristic tool for analysis of the Sub-Saharan city (Ricci 2011, 2014).

future with clearly established goals” (ibid.), and forces planners to focus on social systems and their relation to resource scarcity.

Notwithstanding Sen’s teaching that human well-being depends on actual access to resources rather than the mere availability of such resources, in most of the literature the availability of human, social, technological, manufactured, and financial capital is considered a proxy for adaptive capacity (Nelson *et al.* 2007; Preston *et al.* 2008; Dunford *et al.* 2013). Only a few authors (Adger *et al.* 2007) challenge this view, drawing on the idea that vulnerability is the result of a process in which the system of social interactions and power relations influences people’s access to resources, and therefore contributes in a determinative manner to defining the kind of vulnerability of a given social group in a given time and place (O’Brien *et al.* 2007; Simon 2010). These different perspectives bring into discussion the role of institutions in building up local adaptive capacity, which is key to defining the specific objectives to be pursued through adaptation mainstreaming. While the former perspective influences the deployment of resources through planning and management by existing governance systems, the latter emphasizes the role that institutions play in determining the conditions of resource access.

This work adopts the second perspective. Moreover, a special activity was designed and implemented to allow the community to play a role in the adaptation mainstreaming exercise. The community was involved in the development of vulnerability scenarios through implementation of participatory backcasting workshops (Faldi 2013 and 2014). The backcasting scenario approach was chosen as an antidote to the risk of placing too great a weight on people’s current adaptation strategies while overlooking their aspirations for change. In other words, vulnerability is not only changing with the context, but is also shaped by the community’s aspirations. The core idea of participatory backcasting is to start by creating a shared, desired vision of the future and to then look backwards to the present to determine what challenges will need to be faced and to assess the potential for change. Through this process the community was able to provide indications of what kinds of action should be taken to change current environmental management and decision-making in order to achieve the desired future.

15.2.3 Operationalizing Adaptation Mainstreaming at the Local Level

At the operational level, a mainstreaming strategy involves four types of change in policy making: procedural, organizational, normative, and policy reframing (Persson and Klein 2008). The first consists of introducing new or modifying existing decision-making procedures while providing targeted information to those tasked with policy development and implementation. The second involves amendments to formal responsibilities and mandates, creating new or merging existing institutions, networking among diverse departments, and structural changes of budgets. The third

entails the formalization of the issue to be mainstreamed in existing strategies and policy frameworks as well as the allocation of additional targeted resources. The fourth aims at reshaping the policy frame of traditional sectors to embed the issue at stake into the thinking of relevant stakeholders.

Given the scope of this study, only changes applicable at the local government level have been considered (i.e. the identification of initiatives for changing existing procedures and organizational structures). Indeed, in the Tanzanian context, any change in policy frameworks requires the involvement of the national government, an action that goes beyond the reach of the ACCDar project. This represents a major limitation of the study. However, although contact with national authorities has been quite limited, the mainstreaming exercise that was carried out to test the proposed methodology also tackled the analysis of planning documents that fall within the competence of state ministries (i.e. master plans for urban development and water supply at the city level) while also being of great concern to municipal councils. The purpose of such analysis was to better understand the developed methodology's potential to enable local authorities to advocate change with state ministries and agencies.

As highlighted in the literature, "climate adaptation is context dependent and it is uniquely linked to location, making it predominantly a local government and community level of action" (IPCC 2013d: 6). However, adaptation efforts undertaken by local governments may be hampered by a variety of factors, including institutional, social, informational, financial, and cognitive barriers (Adger and Barnett 2009). Here the focus is on barriers in the existing institutional framework, since mainstreaming requires institutional changes of various kinds and at various levels. In particular, the relationships between local authorities and the national government are considered.

One barrier to effective mainstreaming of adaptation at the local level is the inadequate capacity of governments to effectively coordinate the range of adaptation initiatives being implemented in their territory, which is especially true in Africa (IPCC 2013e). This is due mainly to unclear and often overlapping roles and responsibilities between levels and actors, which inhibits knowledge production and circulation, and is aggravated by obstacles in national, subnational, and local governmental approaches to addressing complex and multidimensional problems, such as climate change adaptation. Besides lack of capacity, there may also be a lack of political will to coordinate. In this respect, it bears mentioning that in Sub-Saharan Africa the tension between national interests in the city as a motor of economic growth and the interests of the majority of the urban population, for whom the city is a resource for achieving individual plans, is increasingly palpable. The existence of competing values and policy priorities among local authorities and the national government may seriously hamper any decision by local authorities to build, support, and reinforce the autonomous adaptive capacity of their citizens.

Secondly, the decentralization and devolution of power and functions from central to local authorities also plays a role in enabling or undermining mainstream-

ing efforts. In Tanzania, despite a number of reforms currently being deliberated by the parliament, decentralization of decision-making and administration remains extremely slow (Lerise 2000). Local government authorities were established following *Local Government Act 7 and 12 of 1982*, but the first Local Government Reform Programme only began in 1998, with a second one initiated in 2011. As a result, the decentralization process has not yet been completed. Key decision making on urban development and major infrastructure remains firmly in the hands of the state. Local urban governments have sole responsibility for providing most services, while a few (electricity, hospitals, secondary education, police, economy, and tourism) are shared with other levels of government (Smit and Pieterse 2014).

This situation leads to a high degree of compartmentalization between sectors, actors, and policies operating at similar administrative levels. In Tanzanian local administrations, although the Municipal Council is attempting to prepare a three-year Strategic Plan and a related Medium Term Expenditure Framework following the national devolution policy, single departments depend more on guidance from their respective ministry than from the local authority. Obviously, the limited financial power of local authorities together with the inadequacy and uncertainty of funding from the national government play a role. However, mainstreaming across different sectors seems more practical at the local scale since conflicts between competing policy goals are more evident and precise than at the national level, as people living in the same place have a shared interest in avoiding local socio-ecological crises that could threaten local commons.

Lastly, power relationships within formal institutions are to be included among the factors that may hinder or enable effective mainstreaming. Local government officers may oppose changes that threaten their interests, including power hierarchies, or are inconsistent with their values and beliefs. The adoption of the mainstreaming approach may also be a cause for concern because it often implies a reduction in the amount of funding dedicated to climate change adaptation. Moreover, the request for greater coordination between different levels and sectors of government may be associated with the threat of increased control of local authorities by national government and donors.

Nevertheless, local authorities represent a formidable resource in terms of guaranteeing that mainstreaming occurs from the bottom-up. Moreover, the need for adaptation can be an impetus for institutional change as well as an opportunity to strengthen the capacities of local governments, both in addressing climate challenges and in advocating for adaptation with higher-level authorities. The present research takes on those challenges and proposes a mainstreaming methodology that has been developed by involving local authorities at all stages while providing their officers with opportunities to share concerns and ideas regarding different policy sectors (including health, waste management, water and sanitation, fire and rescue, disaster management, transportation, urban planning, agriculture and livestock, natural resources, civil and environmental engineering) (see Chap. Shemdoe *et al.*).

15.3 Developing a Mainstreaming Methodology

A mainstreaming methodology has been developed and tested on four planning documents. This methodology represents only one stage of a lengthier process that involves: (i) assessing the need to build local authorities' adaptation capacity, (ii) exploring the adaptive capacity of households and identifying their main concerns in a changing environment (i.e. a decrease in freshwater availability in the coastal aquifer), (iii) assessing the coastal aquifer's sensitivity to seawater intrusion caused by climate change and urban sprawl, (iv) defining adaptation objectives in cooperation with the community, and (v) developing a strategy for adaptation mainstreaming with a selected group of municipal officers. Following the mainstreaming exercise, key initiatives will be identified and implemented by local authorities to improve their capacity to support peri-urban households' efforts to adapt to a changing environment.

15.3.1 Methodology Outline

A mixed team of urban planners, environmental engineers and a hydrogeologist from Sapienza (Italy) and Ardhi (Tanzania) universities⁴³ developed the methodology and carried out the mainstreaming exercise. Although the whole activity took six months to complete, the mainstreaming exercise is designed to last for a period of two months.

The methodology is composed of three phases, preceded by the initial selection of the planning provisions to be analyzed. Phase 1 consists of assessing the selected planning provisions to identify adaptation needs. In phase 2, a set of amendment options is identified for each planning provision under review. In phase 3, the most feasible or suitable amendment options are chosen and recommendations are formulated for their implementation (Figure 15.1).

Assessment criteria for phase 1 include: (i) two adaptation concerns (ACs), both related to water resources because access to fresh water was a top priority due to the increasing salinization in the study area; (ii) three possibilities for autonomous adaptation (PAAs), identified on the basis of a series of household interviews and participatory workshops; and (iii) several criteria related to mitigation, included in order to integrate this goal into the process. Planning provisions were assessed against each of these criteria to identify negative and positive impacts. More details are provided in Table 15.1.

⁴³ The team included Liana Ricci, Carlo Norero, and Giuseppe Sappa from Sapienza University of Rome, and Riziki Shemdoo and Gabriel Kassenga from Ardhi University.

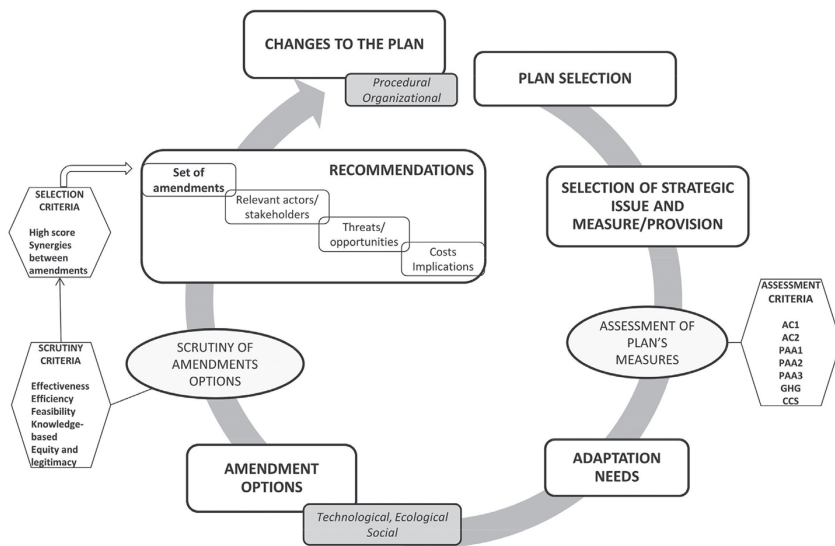


Figure 15.1: Methodology Diagram.

Table 15.1: Phase 1 criteria for assessment of planning provisions.

ADAPTATION CONCERNS		
AC1	water resource conservation	to assess whether a planning provision interferes positively or negatively with the recharge rate of coastal aquifers, prevents or increases the risk of groundwater pollution, and causes a decrease or increase in groundwater extraction
AC2	access to fresh water	to assess whether a planning provision implies a drop or a rise in household costs to access water
POSSIBILITIES FOR AUTONOMOUS ADAPTATION		
PAA1	water source diversification	to assess whether a planning provision increases or reduces the variety of water sources upon which residents can rely
PAA2	changes in income generating activities	to assess whether a planning provision facilitates or impedes residents in adapting their economic activities to cope with environmental changes
PAA3	changes in settlement patterns & relocation	to assess whether a planning provision supports or hinders household capacity to make structural changes in their living place or relocate
MITIGATION CONCERN		
GHG	greenhouse gas emissions	to assess whether a planning provision implies a reduction or an increase in greenhouse gas emissions
CCS	carbon capture and sequestration	to assess whether a planning provision implies a reduction or an increase in local capacity to capture or sequester carbon dioxide

Next, a list of Adaptation Needs (AN) was drawn up on the basis of their potential impacts. According to the nature of the impacts that a given planning provision is expected to induce, three types of Adaptation Needs were proposed:

- need to completely revise – the provision only has negative implications (AN1);
- need to strengthen or adjust the provision to better address the threats detected (AN2);
- no need to change – the provision has no negative impact on any issues considered (AN3).

Planning provisions were selected for analysis at the request of local officers, with a focus on provisions that, with minor changes, could qualify as adaptation measures for funding purposes. As such, only cases of AN2 were likely to be analyzed. The following methodological phases were developed, with a special focus on that kind of adaptation need.

In phase 2, a set of amendment options was designed for each of the AN2 identified in the previous stage. From the literature (IPCC 2012), three different approaches for tackling adaptation can be discerned: (i) applied technological and infrastructure-based approaches (e.g. provide new water infrastructure); (ii) investing in natural capital and ecosystem-based adaptation (e.g. preserve, maintain and expand natural habitat); and (iii) human development and vulnerability reduction (e.g. improve regulation of access to water). Technological, social, and ecological options can be combined since they are often interdependent and synergetic. The zero-option (no change) should also be considered.

In the third stage of the process, each set of amendment options is scrutinized in order to select those that are most feasible and suitable. To that end, the following criteria were considered:

- Effectiveness: sustainability and flexibility
- Efficiency: costs and benefits, low-regret, no regret, and win-win-win sub-criteria
- Feasibility: technical, social, and institutional barriers to implementation
- Knowledge base: knowledge gaps limiting amendment implementation, and potential of the amendment to bridge the gap between knowledge and action
- Equity and legitimacy

Through a scorecard, the highest scoring amendment options in each set were selected. Potential synergies were also considered.

Finally, instructions were provided on how to implement the selected amendments, including how to identify the actors and stakeholders to be involved, the opportunities and threats (e.g. technical, social, institutional, etc.) associated with the option, and the cost implications to be considered.

15.3.2 Data Collection

In keeping with scope of the ACCDar project, which focuses on under-served peri-urban neighborhoods in the Dar es Salaam coastal plain, the planning documents used in the mainstreaming exercise were selected with a focus on peri-urban areas facing the problem of groundwater salinization due to seawater intrusion. Accordingly, a pilot mainstreaming exercise was conducted with Temeke Municipal Council, since most of Temeke lies within the coastal plain and consists of peri-urban and rural areas, with the latter expected to convert into peri-urban in the coming years. The Strategic Plan and Medium Term Expenditure Framework documents for years 2010/2011–2012/2013 were provided by the Temeke Municipal Council.

Hydrogeological surveys indicate that seawater intrusion already represents a major vulnerability concern in neighborhoods where boreholes are the main source of water, and intrusion is expected to progress even faster under future conditions of climate change and urban sprawl. It should be highlighted that the actual rate of water extraction from the coastal aquifer already exceeds the recharge rate (see Chap. Sappa). In the future, the combined effects of climate change and urban development are expected to further reduce the natural recharge capacity of the coastal aquifer, while groundwater withdrawal is likely to increase due to the growth of both domestic and productive demand. In light of these considerations, researchers focused on existing planning documents relevant for future urban development and water supply in the Temeke territory. Draft versions of two additional documents were obtained: the “Dar es Salaam Master Plan 2012–2032”; and the “Strategic Water Supply and Sanitation Plan for Dar es Salaam”.

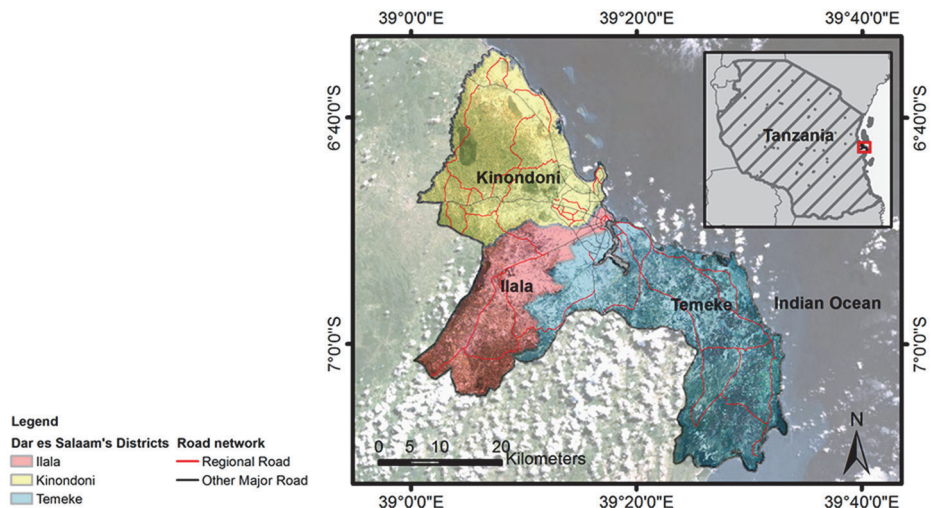


Figure 15.2: Location of Dar es Salaam and its three municipalities.

All four Temeke plans were reviewed. For each plan, one key issue and two related provisions were selected for further assessment.

From the two municipal planning documents, the objectives “management of natural resources” and “environmental improvement” were selected as the key issues to focus on, and the specific provisions chosen for assessment were protection of green areas, forest conservation, tree plantation, and demonstration toilet construction.

From the Water Supply and Sanitation Plan, the objective “Develop a long term water supply strategy improvement plan (25 year horizon) for improving/expanding water supply services for Dar es Salaam” was selected as a key issue, with a focus on the provisions: (i) improving surface water sources from 276,000 m³/d to 576,000 m³/d ultimate capacity by 2032; and (ii) installation of 20 deep wells with a minimum depth of 600 m in Kimbiji and Mpera.

Under the Dar es Salaam Master Plan 2012–2032, the key issue selected to focus on was “Design Guidelines” and the building provisions selected for assessment related to: (i) consolidation process zone; and (ii) peri-urban areas and urban agriculture zone.

Results from the analysis of the latter provision are presented below as an example of the methodology outputs, while the whole process, from impact detection to recommendation of a single adaptation need, is summarized in Table 15.2.

15.4 Preliminary Results: Amending Building Provisions for Peri-Urban Areas

The Dar es Salaam Master Plan 2012–2032, which still was under consultation at the time of writing, sets out the objectives and policies aimed at achieving a shared vision of the metropolitan city for the next twenty years. It defines the direction of territorial development and provides for a system of rules and procedures for its implementation.

The proposed mainstreaming methodology has been tested with two planning provisions under Section 2 “Proposed Land Use Zones” and the related parts of Section 3 “Town Planning and Building Standards” of the Design Guidelines. Special attention has been paid to the consequences of those provisions for the future development of peri-urban areas in the southern part of the Dar es Salaam region, which falls under the authority of the Temeke Municipal Council. Recommendations for adaptation mainstreaming are likely to be more productive in areas that are still mostly undeveloped and therefore provide a more favorable context for transition to sustainable settlement patterns.

The results reported below relate to Art.18 of the Design Guidelines, as formulated in the Draft Final Report of the Master Plan (kindly provided by the planning team).

Table 15.2: From impact assessment to recommendation. An example from the mainstreaming exercise for the measure “Protection of environment and reserved areas in 4 wards enhanced by 2013”, Temeke Municipal Council Strategic Plan for years 2010/2011–2012/2013.

ASSESSMENT CRITERIA	EXPECTED IMPACTS	ADAPTATION NEEDS	AMENDMENT OPTIONS	RECOMMENDATIONS
AC1
AC2	NEGATIVE IMPACT: When natural water sources in the reserved area currently provide free water to residents, the provision might increase water access costs	AN2: Need to provide options for ensuring no additional fresh-water access costs	<p>No change option</p> <p>TECHNOLOGICAL OPTIONS</p> <ol style="list-style-type: none"> 1. Review reserved area boundaries in a way that will not prevent residents from accessing existing natural water sources 2. Provide new infrastructure for pumping freshwater from within the reserved area to a free water point located outside <p>ECOLOGICAL OPTIONS</p> <ol style="list-style-type: none"> 3. Set up a water body monitoring system to inform decisions on the quantity of water that residents can extract while respecting conservation goals (e.g. minimum water table level or minimum river flow) <p>SOCIAL OPTIONS</p> <ol style="list-style-type: none"> 4. Set up a local water committee to guarantee equitable access to and distribution of natural water sources (including participatory monitoring of water bodies) 5. Identify alternative free water sources outside the reserved areas 6. Provide an adequate amount of free freshwater to poor households (change in water service tariff) 	<p>When natural water sources within the reserved areas currently provide free water to residents, the measure shall be amended to include the set-up of a local water committee to guarantee equitable access to and distribution of natural water sources (including participatory monitoring of groundwater and surface water bodies) (Option 4).</p> <p>While there is a need to limit water extraction from the shallow aquifer in general, the committee shall be provided with clear direction on the quantity of water that residents can withdraw from surface water sources without affecting the eco-system functioning (Option 3).</p>
PAA1
PAA2
PAA3
GHG
CCS

Article 18 – Peri-urban areas / urban agriculture

18.1 – *These are the parts of the territory outside the urban perimeter, characterized by a strong prevalence of agricultural or potentially agricultural areas and low residential density.*

18.2 – *In these areas, all possible transformations of an agricultural nature are allowed, including the construction of residential and / or service buildings, related to the agricultural activity.*

In the case of dispersed settlements, the new residential buildings may not exceed the density of one new dwelling per hectare.

18.3 – *The Municipalities may decide to establish a perimeter around existing settlements at the date of approval of the Plan, to which the prescriptions of Article 744 of the present Rules will apply. (Dodi Moss et al. 2013: 300).*

This set of planning provisions is of particular importance with regard to mainstreaming CC adaptation into the Master Plan, as it will impact large areas in Dar es Salaam region where people's livelihoods are expected to remain highly dependent on natural resources. Climate change will particularly affect these areas, and special efforts are therefore needed to maintain and develop their adaptive capacity while preventing mal-adaptation. To do so, multiple amendments are required.

15.4.1 AC1: Water Resource Conservation

This article focuses specifically on areas where the predominant land use is agriculture. This may put groundwater resources at risk for several reasons. Firstly, increased use of fertilizers and pesticides will result in water contamination and soil pollution. Secondly, increased demand for water for farming uses (i.e. irrigation and livestock breeding) will increase the rate of water withdrawal from the shallow aquifer. To avoid these impacts, sustainable cultivation techniques should be promoted and the use of chemical fertilizers discouraged or prevented. We therefore propose amending the measure to include the development of pilot projects on sustainable cultivation techniques, including organic (chemical free) farming and water saving techniques (i.e. micro-irrigation and net-houses). To complement this action, an additional amend-

44 Article 7 – Urban redevelopment areas

7.1 – *These are the parts of the city, mainly residential, characterized by low quality of settlements, low building density and the lack of any urban structure.*

7.2 – *In these parts of the city the replacement of existing buildings with more appropriate ones, that do not exceed the height of three storeys, is to be carried out. All developments should meet the planning and building standards as defined in Section 3.*

7.3 – *In these parts of the city all measures are planned to provide them with adequate roads, the necessary infrastructure networks (water, sewerage system, electricity), adequate space for urban facilities and green areas. (Dodi Moss et al. 2013: 296–297)*

ment could be introduced to provide for the development of initiatives to facilitate learning and sharing of experiences from pilot projects, thereby raising awareness of the benefits of sustainable cultivation techniques among peri-urban communities.

The expansion of built-up areas in the peri-urban zone may aggravate the aforementioned impacts on water source conservation. This is especially true where the redevelopment of existing settlements will occur without simultaneous provision of adequate water supply, sanitation systems, and waste management. To prevent increased water source contamination, soil pollution and groundwater overexploitation, the article should be as amended to require the existence of adequate water supply and sanitation infrastructure and solid waste management as a condition for issuing any new building permit in existing settlements. Meanwhile, at least two additional amendments should be considered to lay the foundation for the design of locally tailored, sustainable infrastructure. First, a monitoring system for underground water levels and quality must be created. Second, a local committee should be set up to ensure community participation in the design, construction and stewardship of new infrastructure.

15.4.2 AC2: Improve Access to Fresh Water

Proper provision of water supply, although highly desirable for water conservation, may entail an increase in household water costs. The same may also occur in areas of increasing competition for water due to the combination of inadequate water service and growing water demand. It is therefore necessary to ensure that no additional freshwater access costs are charged to residents as a consequence of water supply upgrading and population growth. In order to keep freshwater affordable for all residents after redevelopment, it is crucial that the measure be amended to provide protection for the cheapest source of potable water (i.e. community water storage facilities) against contamination and vandalism. The measure should also be amended to include the set-up of local committees in charge of guaranteeing equitable and affordable access to fresh water for residents. Such committees may also initiate steps towards establishing economic agreements with high water consuming companies (e.g. intensive stock-breeders) to keep domestic water bill low.

15.4.3 PAA1: Possibility to Diversify Water Sources

In peri-urban areas, competition for water between domestic and agricultural uses is likely to intensify, and may decrease the variety of water sources available to households for domestic uses. To combat the risk of reducing the diversity of water sources for households, conflict-resolution institutions and tools are needed. We highly recommend complementing the set of provisions under Article 18 with the set-up of

local committees to manage conflicts between households and farmers over access to freshwater. Such committees could also represent peri-urban communities in negotiations with high water consuming companies, where compensation for ecological damage could be established and contribution to the development of new sources of water through run-off harvesting and water reuse could be requested.

15.4.4 PAA2: Possibility to Change Income Generating Activities

Regarding the negative impacts on income generating activities, it should be noted that implementation of the planning provisions under consideration may affect the agricultural practices of residents, both in existing settlements and in rural areas throughout the region.

The redevelopment of existing settlements may lead to the exclusion of agricultural uses from residential areas and, in general, a disconnect between agricultural and urban activities. The need therefore arises to preserve agricultural uses within urban areas while ensuring connections between agriculture production and food markets. To that end, we suggest amending the article to require the preparation of a special plan for the protection and development of agricultural and agriculture-related uses near and within urban boundaries. Such a plan should consider water availability as a limiting factor and should secure adequate space for future provision of market facilities. In addition, as an incentive towards more sound agricultural practices, an amendment may be introduced to issue land titles to residents who adopt sustainable farming and water management techniques.

In the case of inadequate management of wastewater and solid waste within dispersed settlements, food-producing farmers may experience an income reduction due to the decreased quality of their products. To prevent crop contamination, we highly recommend providing for awareness raising initiatives on the health and economic risks associated with uncontrolled discharge or improper reuse of wastewater and solid waste in agricultural areas. In addition, the set-up of a local committee to control and promote the quality and safety of food production may be introduced.

15.4.5 PAA3: Possibility for Relocation or Changes in Current Settlement Patterns

A further problem is that the regulations for new settlements defined under the measure may be rejected by residents, and would therefore be completely ineffective and/or may cause residents to migrate elsewhere. It should also be noted that these regulations pay little attention to the environmental impacts of new settlements. Therefore, there is a need to ensure residents' involvement in decision-making that impacts their settlement needs, while enhancing the environmental performance of decisions made according to the measure. We suggest providing for the set-up of a

local committee responsible for managing potential conflicts that may arise during implementation. In addition, the regulations provided for new settlements should be amended to include the preservation of natural areas with high ecological value (e.g. wood- and wetlands), and to protect highly productive farmland from residential encroachment.

15.4.6 Contribution to Greenhouse Gas Emissions (GHG) and Carbon Capture/Sequestration (CCS)

Lastly, the article does not consider that future growth in farming activities and the settled population within peri-urban areas will lead to an increased mobility and energy demands, thus causing a negative impact on the environment in terms of GHG emissions. The GHG emissions associated with these new demands must be contained through the promotion of low carbon and energy efficient techniques and systems in the sectors of transportation, agriculture, and energy production. To meet this need, several amendments should be introduced. Firstly, increased emissions could be offset by innovative farming techniques to minimize release of soil carbon, such as organic agriculture and minimum tillage techniques. Secondly, raising awareness initiatives of the environmental impacts of private car transport and fossil based energy production is highly recommended to create a more favorable context for the diffusion of low carbon transport (including public transport service, non-motorized mobility and low carbon vehicles) and energy production (e.g. renewable energy), as well as more energy efficient engines.

15.5 Conclusions

Although results from the analysis of the four selected planning documents still need further examination, the proposed methodology for mainstreaming adaptation into existing urban development and environmental management plans and programs at the local level is definitely valid. In-depth examination of a selection of planning provisions enabled the research group to identify a few key mainstreaming initiatives whose reach goes far beyond the improvement of a single planning document. In other words, what emerges from the analysis of a specific planning provision has the potential to be generalized, and provides clear directions as to how to proceed in order to mainstream adaptation into the whole planning system, which is the ultimate scope of this work.

Those directions include: (i) the development of pilot projects to encourage locally the adoption of best available technologies in a range of fields such as agriculture, forestry, construction, transport, energy, water supply, and waste treatment; (ii) the creation of locally based, participatory monitoring systems to allow for adaptive

management of natural resources; (iii) the set-up of local committees with the twofold role of guaranteeing wise and equitable use of resources within the community while also representing the community at local meetings; and (iv) facilitating increased use of ecosystem services payment schemes, such as Equitable Payment for Watershed Services (EPWS), as a way of financing local development while preventing irreversible environmental damages.

It is beyond the scope of this chapter to evaluate the acceptability and potential effectiveness of the mainstreaming initiatives that arose from this exercise. In order to do so, a systematic assessment of the barriers and opportunities that may arise would be necessary (Moser and Ekstrom 2010), to be carried out with direct involvement of all government levels and stakeholders. Considering the present state of the research, the principal conclusions that may be drawn from this preliminary application of the proposed methodology mainly concern possible improvements of the methodology itself. Indeed, there is high agreement among the research group that some revisions would be necessary to simplify the process, particularly concerning the second phase, and to ensure more robust results.

Firstly, the number of criteria for evaluating the amendment options could be reduced, and unnecessary repetition and redundancy eliminated. The use of those criteria require too much time and effort. Also, a preparatory stage should be introduced to ensure that criteria are agreed upon and understood by all participants. Although a number of revisions were made to criteria definitions during the course of their application, differing interpretations can still occur.

Secondly, the formulation of amendment options is largely based on the experience and intuition of the people involved. The results would be more balanced if developed through a focus group of stakeholders, experts from different disciplines, and policy makers. However, while the identification of adaptation needs was quite easy thanks to the mass of in-depth knowledge available, the design of amendment options has been affected by the lack of a clear understanding of the existing institutional framework, both formal and informal. We intend to fill this gap in the coming months as a basic step towards more effective assessment of the barriers and opportunities in implementing the mainstreaming initiatives identified within this study.

Finally, the nature of the planning documents selected for analysis seems to make a difference in terms of ease of application. It appears that the more executive the planning documents under consideration, such as the Medium term expenditure framework and the Strategic plan of Temeke Municipal Council, the more targeted and viable the indications for amendment. This may depend on the structure of the proposed methodology. However, it offers an argument in favor of the importance of “the local” in determining the efficacy of adaptation mainstreaming.

References

- Adger, W.N., S. Agrawala, M.M.Q. Mirza, C. Conde, K. O'Brien, J. Pulhin, R.S. Pulwarty, B. Smit, and K. Takahashi. 2007. Assessment of adaptation practices, options, constraints and capacity. In *Climate change 2007: Impacts, adaptation and vulnerability. Contribution of working group II to the fourth assessment report of the IPCC*, ed. M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson. Cambridge: Cambridge University Press.
- Adger, W. N., and J. Barnett. 2009. Four reasons for concern about adaptation to climate change. *Environment and Planning A* 41(12): 2800–2805.
- Agrawala., S. ed. 2005. *Bridge over troubled waters: linking climate change and development*. Paris: OECD publishing.
- Anguelovski, I., and J. Carmin. 2011. Something borrowed, everything new: Innovation and institutionalization in urban climate governance. *Curr. Opin. Environ. Sustainability* 3(3): 169–175.
- Carmin, J., I. Anguelovski, and D. Roberts. 2012a. Urban climate adaptation in the global South: Planning in an emerging policy domain. *Journal of Planning Education and Research* 32(1): 18–32.
- Carmin, J., N. Nadkarni, and C. Rhie. 2012b. Progress and challenges in urban climate adaptation planning: Results of a global survey. Cambridge, MA: MIT.
- Congedo, L., and M. Munafò. 2014. Urban sprawl as a factor of vulnerability to climate change: Monitoring land cover change in Dar es Salaam. In *Climate change vulnerability in southern african cities: Building knowledge for adaptation*, ed. S. Macchi, and M. Tiepolo, 73–88. Springer. doi: 10.1007/978-3-31900672-7.
- Davoudi, S., J. Crawford, and A. Mehmood. 2009. Climate change and spatial planning responses. In *Planning for climate change. Strategies for mitigation and adaptation for spatial planners*, ed. S. Davoudi, J. Crawford, and A. Mehmood, 7–19. London- Sterling (VA): Earthscan.
- Dodi Moss, Buro Happold, Afri Arch, Q-Consult. 2013. Dar es Salaam Masterplan 2012–2032. Main Report. Final Draft, Feb.
- Dunford, R., P.A. Harrison, J. Jäger, M.D.A. Rounsevell, and R. Tinch. 2013. Report on assessment of vulnerability across Europe and the identification of vulnerability hotspots. The CLIMSAVE project climate change integrated assessment methodology for cross sectoral adaptation and vulnerability in Europe. <http://www.climsave.eu/>. Accessed 15 May 2014.
- Faldi, G. 2013. The use of backcasting scenario for planning adaptation to climate change in Sub-Saharan urban areas. Paper presented at the AESOP Conference, 15–19 July 2013, UCD – Dublin. <http://aesop-acspdublin2013.com/uploads/files/AESOP-ACSP%20Congress%20Book%20of%20Abstracts.pdf>. Accessed 15 May 2014.
- Faldi, G. 2014. A Backcasting scenario methodology for planning adaptation to climate change in coastal Dar es Salaam. Paper presented at the AESOP Conference, 9–12 July 2014, Utrecht. <http://www.congrexprojects.com/docs/default-source/aesopdocs/aesop-abstract-book.pdf?sfvrsn=0>. Accessed 28 July 2014.
- Faldi, G., and M. Rossi. 2014. Climate change effects on seawater intrusion in coastal Dar es Salaam: Developing exposure scenarios for vulnerability assessment. In *Climate change vulnerability in southern african cities: Building knowledge for adaptation*, ed. S. Macchi, and M. Tiepolo, 57–72. Springer. doi: 10.1007/978-3-31900672-7.
- Friedmann, J. 2005. Globalization and the emerging culture of planning. *Prog Plann* 64(3): 183–234
- Füssel, H.M., and R.J.T. Klein. 2006. Climate change vulnerability assessments: An evolution of conceptual thinking. *Climatic Change* 75: 301–329.
- Halloran, A., and J. Magid. 2013. Planning the unplanned: incorporating agriculture as an urban land use into the Dar es Salaam master plan and beyond. *Environment and Urbanization* 25: 541–558.

- Huq, S., A. Rahman, M. Konate, Y. Sokona, and H. Reid. 2003. Mainstreaming adaptation to climate change in least developed countries (LDCs). London: IIED.
- IPCC. 2012. Managing the risks of extreme events and disasters to advance climate change adaptation. A special report of working groups I and II of the Intergovernmental Panel on Climate Change. Cambridge-New York: Cambridge University Press.
- IPCC. 2013a. Glossary. In *Final draft of the working group II contribution to the IPCC fifth assessment report climate change 2014: Impacts, adaptation, and vulnerability*. <http://ipcc-wg2.gov/AR5/report/final-drafts/>. Accessed 15 May 2014.
- IPCC. 2013b. Technical summary. In *Final draft of the working group II contribution to the IPCC fifth assessment report climate change 2014: Impacts, adaptation, and vulnerability*. <http://ipcc-wg2.gov/AR5/report/final-drafts/>. Accessed 15 May 2014.
- IPCC. 2013c. Foundations for decision-making. In *Final draft of the working group II contribution to the IPCC fifth assessment report climate change 2014: Impacts, adaptation, and vulnerability*. <http://ipcc-wg2.gov/AR5/report/final-drafts/>. Accessed 15 May 2014.
- IPCC. 2013d. Adaptation planning and implementation. In *Final draft of the working group II contribution to the IPCC fifth assessment report climate change 2014: Impacts, adaptation, and vulnerability*. <http://ipcc-wg2.gov/AR5/report/final-drafts/>. Accessed 15 May 2014.
- IPCC. 2013e. Africa. In *Final draft of the working group II contribution to the IPCC fifth assessment report climate change 2014: Impacts, adaptation, and vulnerability*. <http://ipcc-wg2.gov/AR5/report/final-drafts/>. Accessed 15 May 2014.
- Klein, R.J.T. 2002. Climate change, adaptive capacity and sustainable development. Paper presented at the expert meeting on adaptation to climate change and sustainable development, OECD, Paris, 13–14 March 2002.
- Lerise, F. 2000. Urban governance and urban planning in Tanzania. In *Urbanising Tanzania: issues, initiatives, and priorities*, ed. S. Ngware, and J.M.L. Kironde. Dar es Salaam: University of Dar es Salaam Press.
- Macchi, S., L. Ricci, L. Congedo, and G. Faldi. 2013. Adapting to climate change in coastal Dar es Salaam. Proceedings of the AESOP-ACSP joint congress. 15–19 July 2013. Dublin. <http://www.planning4adaptation.eu/Docs/newsInfoMaterial/01-2014/Paper-AESOP-Track3-MACCHI.pdf>. Accessed 15 May 2014.
- Macchi S. 2014. Adaptation to incremental climate stress in urban regions: Tailoring an approach to large cities in Sub-Saharan Africa. In *Climate change vulnerability in Southern African cities: Building knowledge for adaptation*, ed. S. Macchi, and M. Tiepolo, 3–18. Springer. doi: 10.1007/978-3-31900672-7.
- Macchi S., and L. Ricci. 2014. Mainstreaming adaptation into urban development and environmental management planning: a literature review and lessons from Tanzania. In *Climate change vulnerability in southern african cities: Building knowledge for adaptation*, ed. S. Macchi, and M. Tiepolo, 109–124. Springer. doi: 10.1007/978-3-31900672-7.
- Moser, S.C., and J.A. Ekstrom. 2010. A framework to diagnose barriers to climate change adaptation. *Proceedings of the National Academy of Science* 107: 22026–22031.
- Nelson, R., P.R. Brown. T. Darbas, P. Kocik, and K. Cody. 2007. The potential to map the adaptive capacity of Australian land managers for NRM policy using ABS data. CSIRO, Australian Bureau of agricultural and resource economics.
- O'Brien, K.L., S. Eriksen, L. Nygaard, and A. Schjolden. 2007. Why different interpretations of vulnerability matter in climate change discourses. *Climate Policy* 7: 73–88.
- Persson, Å., and R.J.T. Klein. 2008. Mainstreaming adaptation to climate change into official development assistance: integration of long-term climate concerns and short-term development needs. In Proceedings of the Berlin conference on the human dimensions of global environmental change, Berlin, 22–23 Feb. 2008.

- Preston, B.L., T. Smith, C. Brooke, R. Gorddard., T. Measham, G. Withycombe, K. McInnes, D. Abbs, B. Beveridge, and C. Morrison. 2008. Mapping climate change vulnerability in the Sydney coastal councils group. Prepared for the Sydney coastal councils group and the Australian greenhouse office. Melbourne.
- Ricci, L. 2011. Reinterpreting Sub-Saharan cities through the concept of “adaptive capacity”. An analysis of “autonomous” adaptation practices to environmental changes in peri-urban areas. Rome: Sapienza University of Rome (Italian), PhD thesis. <http://padis.uniroma1.it/handle/10805/1375>. Accessed 15 May 2014.
- Ricci, L. 2014. Linking adaptive capacity and peri-urban features: The findings of a household survey in Dar es Salaam. In *Climate change vulnerability in southern african cities: Building knowledge for adaptation*, ed. S. Macchi, and M. Tiepolo, 89–107. Springer. doi: 10.1007/978-3-31900672-7.
- Rugai, D., and G.R. Kassenga. 2014. Climate change impacts and institutional response capacity in Dar es Salaam, Tanzania. In *Climate change vulnerability in southern african cities: Building knowledge for adaptation*, ed. S. Macchi, and M. Tiepolo, 39–56. Springer. doi: 10.1007/978-3-31900672-7.
- Satterthwaite, D., S. Huq, M. Pelling, H. Reid, and P. Romero-Lankao. 2007. Adapting to climate change in urban areas: the possibilities and constraints in low- and middle-income nations. Human Settlements Discussion Paper Series, 1. London: IIED.
- Simon, D., 2010. The challenges of global environmental change for urban Africa. *Urban Forum* 21(3): 235–248.
- Smit, W., and E. Pieterse. 2014. Decentralisation and institutional reconfiguration in urban Africa. In *Africa’s urban revolution: Policy pressures*, ed. S. Parnell, and E. Pieterse, 148–186. London: Zed Books.
- United Republic of Tanzania. 2013. National account of Tanzania mainland 2001–2012. Dar-es-Salaam: National Bureau of Statistics.