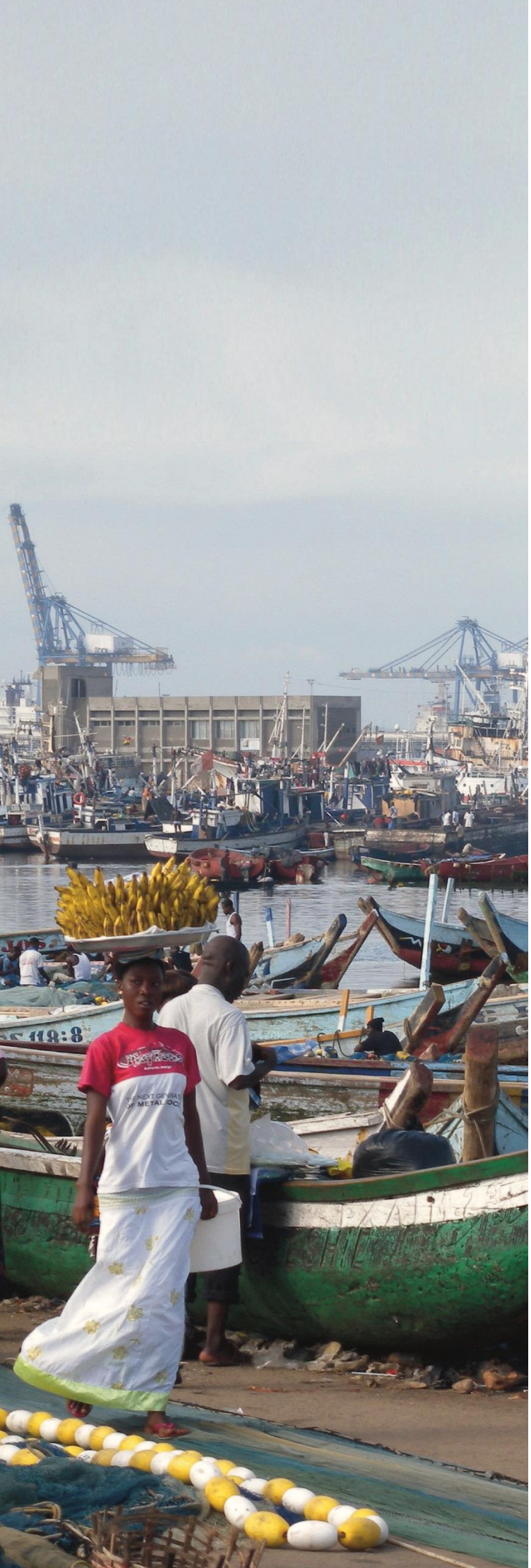

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Risk and Adaptation in (African) Cities

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Abstract

Both water scarcity and flood risk are increasingly turning into safety concerns for many urban dwellers and, consequently, become increasingly politicised. This development involves a reconfiguration of the academic landscape around urban risk, vulnerability and adaptation to climate change research. This paper is a literature assessment of concepts on disaster risk, vulnerability and adaptation and their applicability to the context of studying water in an African city. An overview on water-related risk in African cities is presented and concepts and respective disciplinary backgrounds reviewed. Recent debates that have emerged from the application of risk, vulnerability and adaptation concepts in research and policy practice are presented. Finally the applicability of these concepts as well as the relevance and implications of recent debates for studying water in African cities is discussed. 'Riskscape' is proposed as a conceptual frame for close and integrated analysis of water related risk in an African city.

Risk and Adaptation in (African) Cities

Fanny Frick

1 Introduction

Both the fifth IPCC assessment report and the World Risk Report published in 2014 stress the particular exposure of African (urban) population to climate change and environmental hazards, including water scarcity and flooding. Freshwater systems are reported to be under increasing pressure from land use change, anthropogenic withdrawal and climate change, with wide-ranging consequences for people's well-being. As stated in the IPCC report, "[in] Africa, extreme weather and climate events including droughts and floods have significant impacts on economic sectors, natural resources, ecosystems, livelihoods, and human health." (Field et al. 2014, p. 42). Marginalised groups are particularly vulnerable to such impacts, for instance the urban poor are particularly exposed to floods (ibid. p. 47). Conventional, mostly quantitative risk assessments that underlie these two important assessments give important insights into socio-economic and environmental interactions that shape the uneven distribution of urban water-related risk. In order to fully understand the conditions of risk and identify strategies for its reduction however it is moreover key to identify underlying processes, relations and perceptions. Various methods and concepts exist to analyse patterns and processes of risk in different disciplines, but an overarching conceptual frame bringing these together is currently lacking. The purpose of this paper is to introduce the multiple dimensions of water related risk particularly for the context of African cities, and to make the case for a conceptual frame that embraces them all.

Urban areas contain large proportions of population at risk. At the same time, adaptation to climate change can entail synergies with urban development e.g. by provision of infrastructure such as storm water drainage (Field et al. 2014). The World Risk report 2014 was published under the title "The city as a risk area" and assesses the accumulation of risk in urban areas, acknowledging that much of the urban growth that is occurring takes place in hazard-prone coastal areas and along deltas. It moreover stresses the "exposure effects of urbanization" observed within cities and neighbourhoods. As indicators for exposure, the assessment refers to parameters on the people exposed to earthquakes, storms, floods, droughts and sea level rise (number of people in cities exposed divided by the population size in a country). The assessment uses parameters on public infrastructure, housing conditions, nutrition, poverty and dependencies, and economic capacity and income distributions as indicators of susceptibility. It looks at parameters on government and authorities, disaster preparedness and early warning, medical services, social networks, and material coverage to assess coping capacity. And it applies parameters on education and research, gender equity, environmental status/ecosystem protection, adaptation strategies, and investment to indicate adaptive capacities. The combined indicators give an approximate estimate of the urban risk in each of the 171 countries assessed. Out of these, 25 Subsaharan African countries are listed among the top third of countries at risk, and none appears in the bottom third of the list. According to the index, small West African countries face the highest risks within the African

continent, with Guinea-Bissau on rank 15 and Gambia on rank 19, closely followed by Niger, Benin, Chad and Cameroon (Bündnis Entwicklung Hilft 2014).

Urban water-related risks are linked to access to safe water and flooding, and result from myriad stakeholder networks and processes across multiple scales in the provision and disposal of water in cities. Tight linkages exist not only between regional development and urban water use, but also between industrial production for global markets and local availability of potable water (Budds, Hinojosa 2012; Chapagain, Tickner 2012; Kaika 2005). Urban water scarcity in cities all over the globe has recently gained attention of media and has been a political battleground in many places. It is increasingly presented, discussed and analysed as a 'security issue' (see for instance (Patrick 2012; Rigby 2015; Spooner 2015; Stetter et al. 2011). In parallel to the 'insecurities' due to scarcity in urban water supply systems, urban 'risk' linked to water overabundance in urban water discharge systems is increasing at a global scale[1]. The latter is an outcome of the disproportionate urban growth in low-lying, coastal areas that naturally inundate on a regular basis, and increasingly so under the influence of climate change (McGranahan et al. 2007), modification of river flows such as in dams and river straightening (Kruse 2010), and urban development without adequate drainage infrastructure, particularly in the Global South (Few 2003). In addition to that, urban uses such as land use change, drainage and sanitation interact with the natural protection provided by ecosystems, including flood retention and groundwater production in coastal areas (Meltzer 1998; Xue et al. 2004). This interaction is influenced by impacts from climate change, such as changes in rainfall patterns and sea level rise.

Both water scarcity and flood risk are thus turning into safety concerns for many urban dwellers and, consequently, become increasingly politicised. This development involves a reconfiguration of the academic landscape around urban risk, vulnerability and adaptation to climate change research, as we will see in the following subsections. Before turning to a review of concepts and respective disciplinary backgrounds however, an overview on water-related risk in African cities is presented. The overview of concepts and how they have been developed in different disciplines is followed by a presentation of recent debates that have emerged from the application of risk, vulnerability and adaptation concepts in research and policy practice. Finally the applicability of these concepts as well as the relevance and implications of recent debates for studying water in African cities is discussed. 'Riskscape' is proposed as a conceptual frame for close and integrated analysis of water related risk in an African city.

1 The terms 'security' and 'risk' are put in inverted commas to underline their constructed nature which plays a considerable role in the politicization of water and flood research, as discussed for instance by Weichselgartner 2002; Stetter et al. 2011; Brauch et al. 2011.

2 Water related risk in African cities

Hoekstra et al. in their assessment of water availability in over 400 river basins across the world conclude "with severe water scarcity occurring at least one month per year in close to one half of the river basins included in this study, our results underline the critical nature of water shortages around the world." (Hoekstra et al. 2012, p. 7). A similarly alarming message is sent in a World Bank report on climate change and disaster risk in cities stating that water shortages and water borne diseases are major impacts from climate change and environmental hazards on urban residents (The World Bank 2011). At the same time flooding is increasingly putting urban residents at risk as floods occur more frequently, partly as a result of climate change, and urbanisation takes place at disproportionate rate in coastal areas that naturally inundate (Few 2003; McGranahan et al. 2007). Four types of urban flooding can be distinguished, namely drainage overflow, large river floods, coastal floods, and flooding from small streams in built-up areas (Douglas et al. 2008).

In their assessment of water scarcity in Africa, Vörösmarty et al suggest infrastructure to be a major solution to water scarcity in Africa as the latter is an issue of distribution rather than availability (Vörösmarty et al. 2005). Basic infrastructure is also a central component in the creation of flood risk in urban Africa as a study conducted by the NGO Action Aid found. According to the authors, "flooding is one of the major factors that prevents Africa's growing population of city dwellers from escaping poverty" (Action Aid 2006, p. 7). Based on the same study Bhattacharya and Lamond (2011) identified two major causes of flooding in African cities, firstly coastal inundation, storm surge and sea level rise, and secondly intense rainfalls. Both types of events are expected to intensify in the context of climate change (ibid.) which is expected to be felt stronger and earlier in West Africa than elsewhere (Niang et al. 2014, p. 8). Urbanisation, land use change and drainage infrastructure design and management influence the type of floods affecting cities, which range from frequent localised floods especially in slums to seasonal inundations and flash floods (Bhattacharya, Lamond 2011).

The West-African coastal strip between Accra and Lagos is severely affected by the myriad changes in the urban water system. In Accra, urban water supply is about to collapse - due to a leaky supply system and exploding prices on the informal market large parts of the population are already facing the so-called 'water crisis'. Coastal flooding is becoming more and more frequent as a consequence of an overstretched drainage system, on-going soil sealing and solid waste blocking sewers, as well as coastal erosion and sea level rise, the latter triggered by climate change (Appeaning Addo, Adeyemi 2013b). The impacts of floods are particularly devastating in informal settlements where in addition to the lack of infrastructure a high population density promotes the spreading of infectious diseases (Adank et al. 2011, 2011; Rain et al. 2011).

The fact that water related risks are created by politicised urban planning and infrastructure development and affect the poor in particular is not specific to

Africa. What is special about water-related risk in African cities is that in the context of scattered data e.g. on climate change impacts and demographics and little knowledge on adaptive capacities there is a particular danger of international development organisations victimising the urban poor instead of targeting their real needs (Adelekan et al. 2015; Douglas et al. 2008). Accra is a city where multiple case studies have been conducted, highlighting the differential vulnerability (Aboagye 2012), interaction of risk from multiple environmental hazards (Appeaning Addo 2013; Appeaning Addo, Adeyemi 2013a; Oteng-Ababio 2013; Stoler et al. 2012), and coping strategies (Abdallah Imam, Tamimu 2015; Addo 2015) in specific neighbourhoods. Obtaining a general understanding of the creation and mitigation of water-related risk in Accra from these studies is however hindered by the lack of an overarching conceptual frame.

3 Key concepts and their evolution in different disciplines

In this section an overview on concepts that are important for analysing risk and adaptation in African cities is presented as a basis for the riskscape framework. It is followed by a comparison of these concepts as they have evolved and are used in different research communities.

As indicated in the introduction, concepts around disaster risk and climate change have not only evolved within disciplinary context, but moreover have been reframed from various sciences and research fields (Cardona 2004). A mismatch in terminology persists for instance in the definitions of *mitigation* and *adaptation* in disaster risk versus climate change research: within the former *mitigation* is used to refer to the circumvention of disasters by means of protection (e.g. evacuation) (Lavell, 2011). *Adaptation* in this context means the prevention of disastrous impacts of hazards, e.g. by migration (Wisner, 2004). By contrast in the field of climate change research, *mitigation* is used to describe all measures that contribute to the reduction of the greenhouse effect (i.e. above all the reduction of greenhouse gas emissions). *Adaptation* includes all measures to reduce the impacts from climate change on society and ecosystems – including those that would be considered *mitigation* in disaster risk management (Birkmann, Teichman 2010).

The fifth IPCC report has made efforts to reconcile and integrate the various definitions and concepts on the table. According to this synthesis which is now widely accepted,

risk is the "potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard" (Agard et al. 2014, p. 1772);

v*ulnerability* is the "propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt" (Agard et al. 2014, p. 1775), and

adaptation is the "process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects. Incremental adaptation [refers to adaptation] actions where the central aim is to maintain the essence and integrity of a system or process at a given scale. Transformational adaptation [is the adaptation] that changes the fundamental attributes of a system in response to climate and its effects" (Agard et al. 2014, p. 1758).

These concepts are highly relevant for studying water in an African city because they draw out the intrinsic link between changes in the physical environment, including water, on the one hand and societal background conditions on the other hand that contribute to the increasing threats to safety and development in many African cities. When applying them however, an understanding of disciplinary backgrounds and disputes is key to avoid interdisciplinary misunderstandings, as the following overview shows.

3.1 Natural sciences

In the natural sciences (environmental sciences), risk was first understood to be the probability of a natural hazardous event such as an earthquake or hurricane to occur. The probability of a hazard and hazard risk was thus defined to be the same thing. This changed towards the 1990s when the likelihood of damage from a hazard was included in the definition of risk, and what had formerly been defined a risk became known as a hazard or threat. In this line of research the causes of a natural hazard are understood to be exclusively environmental. Damages or impacts are defined in terms of quantifiable material loss and demographic characteristics, i.e. exposure as the amount of people and material in a hazard-prone area. According to this definition Risk equals to Hazard x Exposure. This conceptualisation of risk is influenced and applied in the insurance industry (Cardona 2004).

3.2 Applied sciences

In the applied sciences such as environmental planning, urban planning, geography, and others the concept of vulnerability gained attention to complement the above definition. Vulnerability can broadly be defined as a potential for loss (Cutter 1996). It incorporates the potential relative impact into the risk equation under the premise that an affluent person is less likely to experience severe damage from a hazard striking than his poor neighbour, even though his material loss in absolute terms might be greater (Cardona 2004). The equation is thus broadened to Risk = Hazard x Exposure x Vulnerability.

A concept increasingly used in DRR and planning research and practice is that of resilience which aims at integrating environmental and social management. Resilience, derived from the concept used in ecology where it describes the ability of ecosystems to bounce back, has been redefined within sustainability science (see subsection below) as "the capacity of a system, be it an individual, a forest, a city or an economy, to deal with change and continue to develop" (Moberg, Simonsen), also (Turner II 2010). In the context of risk and environmental hazard, it refers to the ability of structures and people to withstand disturbances such as floods (Adger et al. 2005). It has become the overall goal of the UN framework for disaster risk reduction (UNISDR 2015).

The concept of '*riskscapes*' that has been developed by geographers describes the environmental injustices causing and caused by the spatial interaction of biophysical and social vulnerability (Boruff et al. 2005; Cutter et al. 2000; Müller-Mahn 2013). It facilitates the spatial representation of biophysical and socioeconomic risk and vulnerability factors and thereby importantly expands the technical view of disaster risk representations that has long been dominating natural and applied sciences. However, we argue that because it currently relies on quantifiable indicators and static data the concept is not apt to capture all the dimensions involved in risk creation, as identified in the literature from social and sustainability sciences.

3.3 Social sciences

In the social sciences concepts around risk and adaptation have evolved in disaster studies which in the mid 20th century primarily studied the way people respond to emergencies, with no particular focus on environmental hazards. Disaster studies were complemented by critical responses to the natural and applied sciences approaches to risk research since the 1970s (Cardona 2004). They turned to constructivist conceptions of socio-environmental risk and vulnerability, stressing that vulnerability is not a predetermined state but defined in social systems and power constellations (Wisner, 2004). Cutter further distinguishes between vulnerability as a pre-existing condition, as tempered response, and as hazard of place (Cutter 1996). A decisive and often underestimated component of the adaptive capacity of social systems is the perception of threat and risk which is constructed in social networks and power constellations (Beck, 2007; Bourdieu, 1983; Castree, 2001; Müller-Mahn, 2007). An additional concept brought in from the social sciences is that of *coping* with disasters which is achieved by short-term action in anticipation of or response to hazards, without taking into account long-term effects, processes or feed-back loops (Birkmann, 2011; Pelling, 2011: 37-39; Wisner, 2004).

Critical social scientists emphasise that the separate evolution of concepts on risk and vulnerability in urban, development and risk/hazard research has led to a fragmented understanding. Specifically the links between poverty

and vulnerability, urban development and risk, and small and large scale hazards are underestimated (Bull-Kamanga 2003). Hazard research has long focused on assessing risk (understood as the probability of an extreme event to occur) and exposure, rather than vulnerability. Urban specialists have been most concerned with building resilience, and development studies have concentrated on poverty reduction (Bull-Kamanga 2003). Yet disasters in urban areas demonstrate that exposure and susceptibility to urban risks is formed by patterns of urban development, and conditions of high exposure and susceptibility tend to correlate with conditions of socioeconomic inequality and poverty. In addition, poverty reduces the ability to prepare for, cope with and adapt to floods and other hazards, and thus negatively affects resilience (Wisner, Luce 1993).

3.4 Holistic approaches and sustainability sciences

In the context of global environmental change, sustainability science has emerged as a separate field, “building toward an understanding of the human–environment condition with the dual objectives of meeting the needs of society while sustaining the life support systems of the planet” (Turner et al. 2003, p. 8074).

3.4.1 Vulnerability and resilience

Vulnerability is a concept that has been addressed within different disciplines, although often implicitly. It has been made more explicit in recent years, and has moreover been reframed in the context of climate change adaptation and sustainability science as these have emerged as separate fields of research (Birkmann et al. 2013). From these holistic approaches, vulnerability can be summarised as the product of exposure and coping and adaptation capacity of a city, a group or a household (Satterthwaite et al., 2009: 20; Turner, 2010). Considering the duration and unpredictability of change in coastal cities, it is evident that vulnerability cannot be reduced by individual short-term measures to build coping and adaptation capacities or to reduce exposure. Instead, an iterative course of action is required. This is implied in the concept of *resilience* of social-ecological systems (SES): The concept derived from systems theory and ecology and developed in sustainability science anticipates an (urban) development that constantly adapts to the carrying capacity of the SES (Turner et al., 2010). The carrying capacity is defined by the stability of the respective system (Pelling, 2011: 42). Here *stability* is not referring to the maintenance or reproduction of a constant status, but rather means the natural change of the basic state (Ernstson et al., 2010; Pelling, 2011).

3.4.2 Adaptation

According to (eco)systems theory, the complex relations of ecological processes (e.g. natural flood retention) and social processes (e.g. managed urbanisation) create a 'social-ecological system' where the mutual influences of social and ecological processes are best understood and managed in an 'adaptive comanagement process' in order to deal with the complexity of cross-scale dynamics and integrated system feedbacks in social-ecological linkages (Folke 2006; Olsson et al. 2004, p. 87). The adaptation literature has evolved particularly in climate change research where it entails adaptation to a variety of climatic disturbances and changes (Birkmann 2011). Pelling (2011) adds two further dimensions to the concept of adaptation from a holistic approach: while adaptation towards resilience aims at the maintenance of functions within a changing environment, adaptation towards transition aims at a comprehensive change of formal planning and governance structures to reduce injustices. Even more comprehensive is adaptation towards transformation that results in a fundamental rearrangement of development mechanisms and structures (ibid.: 50-51).

3.4.3 Adaptive capacity

Adaptive capacity refers to the ability of a system to adjust practices and modify processes in response to experienced or expected change in socio-economic and ecological conditions in order to maintain key system functions (Brooks et al. 2005; Folke 2006; Pahl-wostl 2009; Pahl-wostl et al. 2010). This ability is the outcome of the combined (material and immaterial) resources or capital available for implementation of adaptive action (Adger, Vincent 2005; Pelling 2011). Adaptive action "drives scope for action, which in turn can foster or hinder future capacity to act" (Pelling 2011, p. 21), and can have unintended consequences for the distribution of adaptive capacity at different scales (ibid.). Understanding patterns and processes in the distribution of adaptive capacity is key in the analysis of riskscapes. This presents a particular challenge in management of multi-level governance regimes such as watersheds (Pahl-wostl et al. 2010). The holder of adaptive capacity (i.e. the system) can be any socio-spatial entity from an individual to a global governance regime (Adger, Vincent 2005). Adaptive capacity is influenced by numerous underlying social factors such as social relationships, social capital (Pelling, High 2005), processes of social learning (Pahl-wostl 2009; Pahl-wostl et al. 2010), the system's complexity and diversity (Pahl-wostl 2009), its structural design ((Pahl-wostl et al. 2010) and resilience (Folke 2006), institutions, availability of information (Pelling 2011), governance, civil and political rights, and literacy (Brooks et al. 2005), amongst others.

Table 1: Influential scholars, typical research questions and key concepts on risk, vulnerability and adaptation used in different research fields. Own compilation based on data from (Wisner, Luce 1993; Cardona 2004; Bull-Kamanga 2003)

Natural sciences	
Hazard research	*Influential scholars*: Frank Press *Research questions*: What are the natural/ environmental triggers that create hazards? *Key concepts*: Rational behaviour; risk as a complex concept, combining objectivist and constructivist views, vulnerability as an outcome of exposure, fragility and lack of resilience
Applied sciences	
Climate Change / Adaptation research	*Influential scholars*: Mark Pelling, Neil Adger Research questions: How do people adapt to climate change? *Key concepts*: vulnerability, coping, adaptation, adaptive capacity
Urban research	*Influential scholars*: Christine Wamsler, Cassidy Johnson, Patricia Romero-Lankao *Research questions*: How can disaster risk reduction be mainstreamed into urban planning? *Key concepts*: Focus on everyday-hazards and resilience
Disaster studies	*Influential scholars*: Susan Cutter *Research questions*: What are human responses to hazards? focus on reducing vulnerability *Key concepts*: vulnerability, risk
Social Sciences	
Development studies	*Influential scholars*: Robert Chambers, Piers Blaikie, Harold Brookfield *Key concepts*: Climate change, adaptation, mitigation, governance, livelihoods
Risk research	*Influential scholars*: Ben Wisner, Terry Cannon, Piers Blaikie, Ian Davis *Research questions*: Who is marginal in society? When? In what kind of situations? *Key concepts*: Vulnerability (defined as the product of susceptibility and coping), marginalization, realist vs deconstructive approaches, Pressure and Release model (PAR), livelihoods, coping
Vulnerability research	*Influential scholars*: Jörn Birkmann *Research questions*: What are the drivers of vulnerability? *Key concepts*: resilience, marginality, susceptibility, adaptability, fragility, and risk
Holistic approaches	
Global change research / sustainability science	*Influential scholars*: B.L. Turner, Claudia Pahl Wostl *Research questions*: Who and what are vulnerable to the multiple environmental and human changes underway, and where? How are these changes and their consequences attenuated or amplified by different human and environmental conditions? What can be done to reduce vulnerability to change? How may more resilient and adaptive communities and societies be built? *Key concepts*: Vulnerability (defined as the product of exposure, sensitivity, resilience), coupled human-environment systems, resilience, governance, risk as a complex concept, combining objectivist and constructivist views, vulnerability as an outcome of exposure, fragility and lack of resilience

4 Applying the concepts – trends and debates

While disciplinary divides within vulnerability research are beginning to be bridged, a further gap remains in practices of environmental management and development planning. Vulnerability is "recognised by scientists as a key factor of risk; but not yet acknowledged by urban planners and decisionmakers" (Müller 2012, p. 193). Next to ignorance, there are further underlying reasons that hamper vulnerability reduction in practice are for instance that decision-makers may also have a stake in reproducing conditions of vulnera-

bility in order to maintain power constellations (Pelling, Dill 2010). Traditional, indicator-based, vulnerability assessments tend towards an over-simplification of the multi-dimensional complexity of vulnerability (Barroca et al. 2006). Within different research communities (namely disaster risk research and sustainability science), it is increasingly being acknowledged that taking into account the myriad aspects of vulnerability, addressing the multiple dimensions of it and conceiving vulnerability as a process rather than a state appears most appropriate (Birkmann 2007; Turner et al. 2003).

Patterns of risk and hazards are produced in social and bio-physical (material) processes, including interactions between the two (Cutter et al. 2000). These urban processes are "infused with relations of power" that create inequalities within these patterns of risk and hazard (Cook, Swyngedouw 2012, p. 1967). Yet risk and vulnerability research in the natural and applied sciences have traditionally focused on understanding the patterns, and have largely overseen the role of practices in their creation (Cutter and Solecki 1996). So have hydrologists, who traditionally assess flood risks by measuring discharge and flow. In combination with meteorological data, these variables were long perceived as sufficient to design structural measures in order to prevent flooding.

A pattern of urban flood risk that is commonly described in traditional flood risk assessments has a spatial dimension in terms of the areas of low elevation and nearby rivers or seashores are most at risk, as well as a temporal dimension describing the frequency at which extreme floods occur (cf Fleming and Frost 2002). Structural measures are designed to prevent a flood extreme that has a probability of occurring once in 100 years (Rickard 2002).

Engineered solutions however often didn't anticipate the vast climatic and land use changes that have contributed to an accelerated pace at which extreme floods now affect urban dwellers (Fleming and Frost 2002)[2]. Rather than those responsible for flood anticipation and prevention, the 'disaster people', i.e. international humanitarian aid organisations such as the Red Cross, national authorities in charge of disaster relief, and often the army are in charge when extreme events that hadn't been adequately prepared for, occur (Wamsler 2006). Large sums of money are generally made available in this stage. Several weeks later, emergency relief organisations withdraw their support, and local and regional governments are left to manage long-term impacts, rebuild and strengthen structures to prevent future flooding. The mismatch in resource allocation is thus linked to the disintegrated work of urban planners, development and disaster professionals, operating at different spatial and temporal scales (Wamsler 2006) reinforcing the uneven distribution of risks. Adaptation to climate change adds as another separate

2 Whether the frequency of extreme floods has increased over the past century is disputed, but without doubt the number of people affected by floods has increased…

field of practice and research as the institutional division into UNFCCC and UNISDR in the UN system illustrates.

As socio-economic and urban development shape adaptive capacity, vulnerability and resilience, and vice versa, there is thus a strong link between urban studies, disaster risk studies, climate change studies, development studies, and the respective communities of professional practice. Mainstreaming of adaptation and disaster risk reduction into development planning is pushed for by international organisations but difficult to put in practice (Wamsler 2006). To be more specific, a major challenge in translating urban adaptation and resilience into practice is the 'spatial and temporal inconsistency' in both planned and unplanned development. What appears most beneficial in one place at a given time such as housing development along a river can trigger risks elsewhere, such as water shortage or pollution downstream (Greiving 2006). A second challenge is the lack of contextualisation of adaptation measures in practice, as Johnson (2012) points out: adaptation measures in the built environment are informed by either the location approach, i.e. land use planning where hazard-prone areas are designated as un-suited for construction, or by the design approach, i.e. building codes to ensure that risks are reduced and not enhanced by constructions in hazard-prone areas. Although the former approach has limited effects in rapidly growing cities where informal settlements are spread across hazard-prone areas, it is widely adopted, also in cities with large informal growth. In informal settlements, the design approach allows for incremental improvements and is considered most fruitful when it supports ongoing coping strategies (Johnson 2012). Similarly Briceño 2015) emphasises the lack of contextualisation of current disaster risk reduction strategies.

The need to integrate the above mentioned strands of research and practice has been increasingly stressed in research and governance frames, and yet concrete framings of how to integrate disaster risk reduction (DRR), urban settlement planning and development are lacking (Wamsler 2009). There is moreover a notable mismatch in scales of knowledge and concepts applied (ibid.). The complex interaction of factors that contribute to (coastal) urban vulnerability demands for action at multiple levels to prevent disasters (Dodman, Mitlin 2011; Pelling 2010). Yet incompatible working priorities, concepts and tools as well as competition for funds among practitioners in disaster risk management, development and urban planning that result from a historic and bureaucratic divide between these disciplines further hinder their integration (Johnson 2012; Wamsler 2006). The disintegration of these areas of practice even contributes to enhancing the vulnerability and exposure of the urban poor to hazards (Wamsler 2006, 2009). In addition, traditional concepts are challenged by unprecedented processes of global change, importantly climate change, and the informal form of urban growth in cities of the global South.

Regardless of an increasing alert of risk, vulnerability and adaptation scholars to the need to integrate these fields of research as well as sustainable development, future UN agendas on these topical issues are discussed at three different conferences in 2015. At the Third World Conference on Disaster

Risk Reduction in Sendai (March 2015) voluntary agreements were sought to overcome current challenges – including the disintegration of disaster risk reduction in all policy fields, lack of awareness on disaster risk, and limited attention to social vulnerabilities (Briceño 2015). In anticipation of the upcoming conferences on Financing for Development (July 2015 in Addis Abeba), the Sustainable Development Summit (September 2015 in New York) and the Framework Convention on Climate Change (UNFCCC; December 2015 in Paris) the negotiations were highly politicised and its unambitious outcomes caused frustration among participants (Ben Wisner 2015; IISD 2015). The separation of discussions in these separate conferences has been criticised by Kelman et al (2015) as a lost opportunity to join efforts in pursuing a common goal, which is currently inhibited by tribalism and vested interests. The authors' conceptualisation of adaptation to climate change sitting within disaster risk reduction which itself forms part of sustainable development would, they argue, overcome these hindrances. Along the same lines it can be argued that the UN Habitat III conference taking place in 2016 with the objective of launching a new urban agenda is duplicating efforts towards objectives that are closely linked to those of the 2015 conferences, and creating another 'tribe' competing for international funds.

5 Towards an integrative analytical framework

5.1 Current challenges in analysing water-related risk and adaptation in African cities

Research on African cities illustrates the need for a shift towards a more integrated framing of urban risk and adaptation that is grounded on contextual understanding rather than funding mechanisms.

Environmental catastrophes such as East African droughts have long shaped the (Western) view of disaster risk in Africa within the concepts of risk, exposure and vulnerability as described above under natural and applied sciences' approaches. These views have led to a number of misconceptions about risk in Africa, namely that disaster risk in Africa a) is caused by natural hazards, b) mostly affects rural areas, and c) requires international intervention (Holloway 2012) quoting Wisner and Pelling). However, more recent research on risk in urban Africa shows the complexity of risks urban dwellers are facing, from both natural and socio-economic hazards, and on a wide continuum from every day small onset disasters to rare extreme events (Benouar et al. 2012; Dodman et al. 2015; Holloway 2012). In the summary of a collection of contributions on disaster risk in urban Africa, Benouar et al (2012) conclude with a long list of urban environmental hazards which influence one another: "The case studies demonstrate that daily life in urban Africa is rife with dangers: inadequate sanitation, shack fire, violence and crime, traffic accidents and industrial pollution. Episodically there may also be building collapses,

large explosions, epidemics, floods or storms. However, national policy-makers, researchers and city managers still tend to look at risk from the point of view of their specialities and give special attention to more conspicuous risk" (Benouar et al. 2012, pp. 200–201).

The same body of literature emphasises the key role of local governments in addressing urban risk which are at the same time often understaffed, underequipped and underpaid in African cities. Conventional views on disaster risk in Africa moreover underemphasise the differential vulnerability of urban dwellers in Africa of which roughly 80% live in informal or slum settlements (Dodman et al. 2015). These differential vulnerabilities are intertwined with the global context of African cities. For instance Nigerian and overseas investment in housing development in Accra, Ghana, is pushing land and housing prices to levels that are out of reach for local residents who are as a result forced to live in hazardous conditions (cf BBC article February 2015; Appeaning Addo 2015). These circumstances lead to conditions where affected residents are able to cope, but not to adapt to water-related risks or build up resilience (Action Aid 2006).

The rural bias in development and disaster research (on Africa) and the haphazard development of cities in recent decades has stood in the way of the development of an African urban theory. Western urban development models hardly apply, but alternative models that might contribute to a better understanding of differential vulnerabilities and adaptive capacities are rare. An exception is the research conducted at the African Centre for Cities chaired by Edgar Pieterse (University of Cape Town 2015).

In summary, the challenges in studying risk and adaptation are that while concepts have been developed independently in different research areas, they cannot be separated from issues of socio-economic (urban) development in practice. An overarching conceptual frame is lacking that is applicable both in theory and in practice, and which could (and should) inform an institutional redesign across all scales. Research/ experience from African cities demonstrates the urgent need for a framing that allows to conduct context-specific assessments of risk, vulnerability and adaptive capacity, a premise for the development of appropriate strategies. Next to paying attention to differential vulnerabilities according to socioeconomic differences / inequalities, it becomes evident from research on African cities that risks cannot be looked at in isolation. Hence in the study of water in an African city it is imperative to understand the distribution of environmental hazards such as earthquakes and storms, technological risks such as fires, as well as socioeconomic and health risks to understand when and where a flood becomes a hazard, and shortage of clean water becomes an issue of water insecurity.

The following discussion of a floodriskscape is an attempt to conceptualise risk and adaptation in a holistic manner that is suited to studying water in an African city.

5.2 Analysing power in riskscapes

The notion of 'landscape' allows conceptualising the material as well as the social, cultural and cognitive processes that create visible as well as invisible patterns of form and function in a spatial unit (Cosgrove 1990; Terkenli 2001), De Groot 2006, Tschakert et al. 2013). Derived from the concept of landscape, 'Riskscape' or 'Hazardscape' are concepts that encompass both the processes that produce risks / hazards, and their spatial distribution. Mustafa (2005, p. 22) defines hazardscapes as "simultaneously, an analytical way of seeing, which asserts power, and a social space where the gaze of power is contested and struggled against to produce the lived reality of hazardous places" (Mustafa 2005, p. 22). The term 'hazardscape' is sometimes used interchangeably with 'riskscape' (cf Cutter et al. 2000). However, as Khan and Crozier point out, they are distinct from one another as "hazardscape depicts the current situation of hazards at a place, [whereas] riskscape illustrates the potential damage" (Khan, Crozier 2009; Morello-Frosch, Shenassa 2006). This distinction becomes clear when contrasting the definitions of 'hazard' and 'risk', as discussed above. Hence while hazardscape focuses on the processes that lead to (uneven) patterns of exposure to disasters (i.e. hazard probability x exposure), riskscape is more concerned with the combined generation of vulnerability and hazard exposure in the "interplay of community and individual [socioeconomic] stressors or buffers" (Morello-Frosch, Shenassa 2006, p. 1151). Dynamics of gender, politics, religion, socioeconomics, etc. tend to create riskscapes in which disadvantaged groups are both most exposed and most vulnerable to environmental hazards (Mair et al. 2011).

Time, Space, and Power are all key dimensions in the analysis of riskscapes (Khan, Crozier 2009; Mair et al. 2011; Morello-Frosch, Shenassa 2006). Cutter et al. (2000) stress the role of socioeconomic and biophysical vulnerability in the assessment of riskscapes, which they identify by spatially intersecting indicators of vulnerability and exposure. The outcome of this method is a map that shows an important dimension of riskscape (the spatial dimension), but is less apt to identify temporal processes and the influence of power (Pelling, pers. comm.). Following Müller-Mahn and Everts' definition of riskcapes as "practised and constituted in practice" (2013: 26) which are "interwoven and need to be analysed in relation rather than in isolation" (ibid.: 27-28), an appropriate analytical frame moreover needs to take into account the role of agency, and spatial dynamics. The authors' approach of defining and analysing riskscapes by agent-based notions of risk and practices is much more flexible in terms of time and scale, but does not address issues of power. The literature review above has hinted to the role of power relations in risk creation through international conventions, bodies and funding, through national and local governments, and through academic framings. We therefore argue that the riskscape concept needs even further enhancement to fully embrace power relations. Social capital, understood as relations of trust, reciprocity and exchange (Adger 2003) and critical institutionalism, looking into

the role of politics in institution-building (Hall et al. 2013), are lenses we propose to add to get an improved understanding on how patterns of risk and adaptation to water-related risk are created.

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