Reg Environ Change (2016) 16:1171–1182
DOI 10.1007/s10113-015-0840-z

ORIGINAL ARTICLE

Contesting adaptation synergies: political realities in reconciling climate change adaptation with urban development in Johannesburg, South Africa

Karen Hetz[1,2]

Received: 25 February 2015 / Accepted: 4 July 2015 / Published online: 28 July 2015

Abstract Strategies to promote synergistic responses to both urban development issues and climate change adaptation have become central to policy advice on adaptation. However, the empirical evidence for the effective utilisation of adaptation synergies in planning practices is insufficient. Taking urban planning in Johannesburg as a case study and using the risks of flooding as an illustrative example, this qualitative study explores how adaptation synergies can be realised in planning practices. In this specific case, significant synergy possibilities in planning practices are not observed. Instead, political challenges of reconciling adaptation measures with planning responses to the considerable developmental challenges of urban divide and multiple urban risks in Johannesburg substantially limit the response space for adaptation practices, including those achievable through synergies. Insights gained in this study underline the necessity of giving greater attention to the empirics of observed synergies. The study provides initial indications that it may be necessary to adjust elements of the conceptual arguments concerning adaptation synergies and related policy advice.

Keywords Urban planning · Adaptation practice · Adaptation barriers · Multiple risks · Global South

Handling Editor: Jamie Pittock.

Parts of the research were conducted during membership in the Dresden Leibniz Graduate School.

Electronic supplementary material The online version of this article (doi:10.1007/s10113-015-0840-z) contains supplementary material, which is available to authorized users.

✉ Karen Hetz
karen.hetz@gmx.de

[1] Climate Change and Sustainable Development, Geography Department, Humboldt Universität zu Berlin, Unter den Linden 6, 10099 Berlin, Germany

[2] School of Architecture and Planning, University of the Witwatersrand, Johannesburg, South Africa

Introduction

Despite mitigation efforts, because of historical emissions and the projected increase in greenhouse gas emissions in the future, climate change cannot be avoided (IPCC 2014). For this reason effective adaptation practices are required. Since "much of [the] key and emerging global climate risks are concentrated in urban areas" (Revi et al. 2014: 12), where there are major concentrations of people as well as economic activities at risk, local-level adaptation responses are especially important in cities. In the Global South, especially, local governments are struggling to address environmental risks that are present even under current climate conditions and are likely to worsen in the future as the result of climate change.

Importantly, it is not only climate change effects, but developmental shortcomings such as poverty, inequality, poor urban services and 'risk-unconscious' or informal urban development that contribute to climate-related risks and vulnerability as well. Hence, it is argued that an effective adaptation strategy must take these aspects into account as risk factors (Adger et al. 2003; Satterthwaite et al. 2009). Furthermore, political and societal support is required to effect sustained response to climate risks. In the Global South, where developmental challenges remain considerable, this support is unlikely to be forthcoming if developmental needs are not addressed together with climate change response (cp. Ziervogel et al. 2010).

Accordingly, synergistic responses to address both development and adaptation challenges have become central to current policy advice that guides adaptation (IPCC 2014). Though there are some remaining conceptual limitations surrounding adaptation synergies, the more serious challenge to developing these synergistic responses is that there is little empirical evidence concerning the ways in which the synergies work—or fail to work—in practice, and what their actual adaptation effects are.

Taking urban planning in Johannesburg, a metropolitan city in the Global South, as an example, I explore how adaptation practices can in fact be implemented, in particular through synergistic responses, in infrastructure and land use planning practices. I look at planning practices particularly because 'poorly' planned or unplanned urban developments can increase human exposure to the risks associated with climate change; on the other hand, effective urban planning may play a potentially meaningful role in adaptation (Wilson and Piper 2010). In addition, urban planning potentially offers a long-range, cross-sectoral and systematic approach (Hurlimann and March 2012; Hutter 2007) which is required for effective urban adaptation (Bicknell et al. 2009; Satterthwaite et al. 2009).

Adaptation synergies

Since development dynamics shape various climate change risks, solutions to climate change challenges are suggested to lie—at least partly—in development responses themselves. Accordingly, adaptation responses need to address the "dynamics between risks and development" (Schipper 2007: 39). Instead of concentrating on the specific impacts of climatic changes ("climate impact centred adaptation"—Dupuis and Knoepfel 2013) that are projected through scenarios, a wider pool of social, economic, and environmental factors which contribute to shaping climate change risks and vulnerability need to be targeted.

Cross-linkages presumably exist between climate adaptation responses and development responses, since depending on how development takes place, it can contribute to shaping climate risks and vulnerabilities. Consequently, strategies to address both development and climate change challenges are needed (Klein et al. 2005; Tompkins and Adger 2003). This argument originates in the recognition of the interrelation between low levels of adaptive capacity that are negatively correlated with development performance, and high levels of climate vulnerability and risk exposure (Smith and Pilifosova 2001). Similarly, there is a correlation between planning performance and the level of risk exposure and vulnerability. For instance, population groups living in settlements characterised by poor shelter standards, insufficient or lacking infrastructure provision (e.g. stormwater drains and attenuation), and disadvantageous locations (e.g. flood plain areas) are understood to be highly exposed to flood risks associated with climate change. Besides, climate adaptation responses that focus on a variety of vulnerability factors are argued to be more tractable for planners than climate impact centred adaptation, which, due to its dependency on scenarios, involves a higher degree of uncertainty (Dupuis and Knoepfel 2013).

Accordingly, synergies can be generated through co-benefits of development responses for adaptation objectives, and vice versa. Adaptive land use practices that promote the preservation of flood retaining wetlands, which can also be used for recreational purposes (Haase et al. 2012), potentially improve the attractiveness of a city for human capital, hence creating economic development synergies. The same applies to infrastructure development; for instance, if the provision of one system, say stormwater drainage, can be linked to improvements in another system, for example roads infrastructure, that is required to meet other development objectives. That way, climate adaptation can also be justified with wider development argumentations (Reyer et al. 2012). In turn, failing to adapt, including through risk-conscious land uses and infrastructure programmes, can threaten sustainable development objectives (e.g. due to an increased likelihood of damages to strategic infrastructure or the destruction of livelihoods by floods). Some writers argue that development responses with co-benefits of environmental risk and vulnerability reduction qualify as adaptive practice, in particular in cases where risk and vulnerability under *current* climatic conditions are addressed. Adaptation, however, needs to include long-term and anticipative responses (Birkmann 2011; Pelling 2011; Schipper 2007).

To date, different opinions exist as to how transformative synergies should be. On the one hand, there are strong arguments to mainstream climate change adaptation into existing and presumably continuing policies and practices, and thereby generate synergistic win-wins (Sharma and Tomar 2010; Huq and Reid 2004; Picketts et al. 2014). On the other hand, it is suggested that adaptation synergies should radically change existing development paths, since it is argued that "the proximate causes of risks […] lie within and are produced by dominant development practices" (Revi et al. 2014: 27). This implies a transformation path while the former is the incremental path. However, Kates et al. (2012) remind us that "the difference between incremental and transformational adaptation may not always be a clear cut". Besides, they may not be as divergent as it perhaps appears at first glance. Mainstreaming climate change adaptation into planning fundamentally changes planning logics and practices for instance (cp. Birkmann and Fleischhauer 2009).

In the literature to date, more trade-offs are recorded than concrete synergies (Howe et al. 2014). Despite few exceptions, the available studies provide little insight into the relationships between environmental challenges, including climate adaptation and *urban* development issues (e.g. Haase et al. 2012; Reyer et al. 2012; Tol 2005). Thus, specific research focus on potential adaptation synergies is needed. If, indeed, this focus does not reveal significant possibilities, then a rethink of the conceptual arguments will be required. For the present, however, the current conceptual framework is used as a "working hypothesis" while the evidence is investigated.

Political barriers to synergistic adaptation

The response space for synergistic adaptation practices is arguably shaped by both the prioritisation of development issues in planning practices and the actual opportunities for synergies in related planning responses. In democracies, the prioritisation needs to be politically justifiable and legitimised. Bai (2007) introduces the 'readiness' argument, postulating that cities in the Global South "are faced with more urgent and pressing local environmental issues [than climate change] and that cities are not ready to deal with global issues in terms of the economic stage of development, financial and human capacity, and people's awareness". At first glance, this argument appears to promote synergistic adaptation: synergistic adaptation is a resource efficient means to realise both adaptation and sustainability goals (Revi et al. 2014). In cases of limited institutional and financial capacities, which many local governments face worldwide (Häußermann et al. 2008; Picketts et al. 2014), most severely in the Global South (Bulkeley 2010), synergetic strategies with development co-benefits may be the preferred and politically most justifiable responses. Bai (2007) also argues that many barriers of local responses to global environmental changes are reflections of contradictory priorities, which must be comprehended and addresses in terms of three scales. She proposes spatial, temporal, and institutional scales.

While the readiness argument, which has also been echoed in the South African context (Roberts 2010), may support synergistic adaptation, it in turn also hints to factors that may limit the response space for synergistic adaptation. It is important to recognise these factors, as they may shape the concrete opportunities to realise synergistic adaptation in planning practices. This aspect will be covered in more detail further on. Bai's scale argumentation, however, applies to responses to manage global environmental changes, such as climate change mitigation. It needs adjustment to the context of climate adaptation, which implies the mitigation of *local* vulnerabilities *to* global environmental changes and does not deal with the mitigation of environmental changes themselves (cp. Parnell et al. 2007). Hence, unlike climate change mitigation, adaptation is an essentially more local than global concern. I would argue that a main challenge of adaptation is not the framing of a global issues as a local concern, as Bai (2007) argues in her scale and readiness argument. Instead, adaptation needs to be reconciled with other planning challenges, while all of these issues play out locally. The prioritisation of concurrent local planning challenges arguably takes place at temporal and thematic scales. These scales may help to describe the contextual factors that shape the political response space in which adaptation synergies can be realised. Due to the difference between mitigation and adaptation, the related prioritisation arguments differ from the scale arguments suggested by Bai.

The thematic scale recognises the pre-existence of various considerable development challenges. These development issues need to be mediated and reconciled. It is their negotiated prioritisation which determines the thematic frame for synergistic adaptation. Many cities in the Global South are characterised by a high degree of social polarisation, including alarming poverty levels and large spatial disparities. The UN-Habitat (2010) underlines that

> Cities as diverse as Nairobi, Buenos Aires, Johannesburg, Mexico City, and Rio de Janeiro are similar in that pockets of wealth and poverty co-exist in close proximity […]. Examples such as these highlight the large disparities between better-off minorities and the many poor, which are also reflected in different degrees of access to […] facilities, public goods, transportation and open space in most cities in the developing world (pp. 52–53).

In such contexts, urban planning needs to catch up with the provision of basic services and infrastructure, for instance in informally developed or underserviced areas. In South Africa specifically, there are historically derived societal expectations to reduce inequalities after political liberation, revealed, for example, in restitution programmes (Hetz and Bruns 2014). This further supports a political prioritisation of planning responses with social distribution benefits, such as the service delivery in the marginalised areas. At the same time, poverty reduction and social distribution responses need to be mediated with growth promoting planning strategies. They may require competing planning approaches and interventions in different urban areas. For example, world class infrastructure is needed in the prosperous areas to serve the demand of businesses and human capital to promote and maintain global competitiveness of a city as a business location.

In addition to the thematic scale, the prioritisation of development issues has to be mediated along the temporal

scale. This scale may be most determining for the successful realisation of adaptation synergies, since adaptation needs a long-term perspective (Birkmann 2011; Pelling 2011; Schipper 2007). In view of the immediate urgency of many development issues in cities in the Global South, there is a tendency towards short-termism in local government, including its planning strategies (Parnell et al. 2007; for South Africa specifically see Roberts 2010; Ziervogel and Parnell 2014). Such a temporal prioritisation of urgent issues and short-range planning practices may significantly disadvantage the implementation of planning projects and programmes that have long-term benefits or less visible or obvious development effects.

Particularly, the prioritisation of short-term responses may limit the possibility to realise adaptation synergies. The further intensification of environmental risks—shaped by climate change and urbanisation patterns—may be perceived as a too distant and abstract issue—in comparison to currently experienced development shortcomings or risks. In the context of Durban, South Africa, Roberts (2010) remarked that the existence of urgent development challenges "result(s) in issues being less urgent to be ignored". In such cases, the prioritisation processes at the thematic scale (mediation of considerable pre-existing urban development issues) and the temporal scale (many of them being urgent) may in effect result in planning practices that support the readiness argument.

Planning is a political process, in which the mediation and reconciliation of different development issues, including climate change adaptation, takes place (cp. Fürst 2008). The challenge in the context of highly divided cities is to find sufficient adaptation opportunities in the prioritised (and politically justified) practices, particularly concerning long-term adaptation. Against this background, the study explores the extent to which opportunities for adaptation synergies can be realised in planning practices.

Methodological approach

Political contexts are factors that shape the possible response space of adaptation and hence can constrain the realisation of adaptation practices, or, alternatively, strengthen adaptation practices. This research builds on conceptual (Adger et al. 2009; Carpenter and Brock 2008; Holling 2001) and empirical work on adaptation barriers (e.g. Picketts et al. 2014; Macintosh et al. 2015; Uittenbroek et al. 2013). Although there is growing interest in identifying barriers to adaptation, studies appear to concentrate on listing limiting factors (Moser and Ekstrom 2010; for South Africa: Pasquini et al. 2013; Ziervogel and Parnell 2014) rather than aiming to understand the "origin or the causal mechanisms" (Dupuis and Knoepfel 2013: 2) by which limits operate (Eisenack et al. 2014; Biesbroek et al. 2013). I am particularly interested in origin factors of adaptation barriers.

This study focusses on contextual adaptation barriers of climate change adaptation and not on barriers that are explained by different perceptions or interests of particular groups. A single case study approach was chosen since it allows in-depth investigations of a phenomenon (in this case adaptation) and the context in which it occurs (the possible origin factors of adaptation barriers). Inspired by Belkin and Blight (1991), the research findings are analysed in reference to the context situation. I acknowledge that the possibility of generalising single case study findings is limited. Nonetheless, insights into the extent to which adaptation synergies are politically possible in Johannesburg may be of value for broader investigations on how contextual conditions and related multiple demands on cities shape the response space for synergistic adaptation in the Global South. Accordingly, the intention here is to contribute to an emergent corpus of work which will offer progressively clearer insight into the extent to which adaptation synergies are politically possible in cities in the Global South, and especially in cities with democratically constituted governments where negotiated prioritisation is required. In this paper, the pre-existing planning challenges posed by the high level of urban divide and multiple socio-economic and environmental risks which planners must address, constitute the referential context situation. Such a contextual situation characterises many cities in the Global South. Contextual adaptation barriers are not immutable, but still relatively stable, since the conditions that shape them are themselves difficult to change. Johannesburg was selected as a case study because its high level of urban divide presents an extreme case for urban planning, in reference to which adaptation practices need to be political legitimised. Urban planning is a political process that must respond to and is embedded in a socio-economic development context. While there has been a strong focus on governance factors (e.g. available resources and capacities, institutional fragmentation, or actors' interests and knowledge) to limiting urban climate change responses both globally (cp. Bulkeley 2010) and in South Africa specifically (Pasquini et al. 2013; Roberts 2010; Ziervogel et al. 2010), contextual limits of adaptation are not yet sufficiently understood. This is despite the recognition that governance constraint do not suffice to explain the observed "gap between the rhetoric and reality of urban [climate change] responses" (Bulkeley 2010).

The subject of this research is to investigate which adaptation practices are and are not politically possible under given context conditions, and why. Thereby, urban

planning is framed as land use management activities and infrastructure interventions that take place under prescriptive regulations and indicative development plans. In Johannesburg, integrated development plans (IDP) guide planning practices, frame the annual municipal budgeting process and the development performance monitoring process, and are embedded in the long-term development strategy *Joburg 2040*. Adaptation practices are planning practices which intentionally or unintentionally have presumed adaptation benefits and are either synergistic or an addition to other planning practices.

A few exceptions notwithstanding (Dupuis and Knoepfel 2011; Roberts 2008), studies on urban climate change adaptation concentrate on the policy level (e.g. mainstreaming adaptation into plans or making sense of climate projections) and marginalise the implementation. A significant part of the political determination of the urban development priorities occurs at the agenda- and target-setting levels of urban planning (Fürst 2008). Agendas and targets frame planning practices and hence may influence adaptation barriers well before implementation (Dupuis and Knoepfel 2013). Therefore, target setting cannot be ignored when investigating adaptation barriers. However, planning targets promise various synergies but often lack specification. Potential contradictions of strategic targets become visible during their translation into planning practices. Therefore, I focus on planning *practices* to investigate contextual factors that may shape adaptation barriers.

A method mix of expert interviews and qualitative document analysis promotes complementary data collection and helps to ensure construct validity (Yin 2009). Sixty-seven planning actors, including political decision-makers, policy-makers, and executive leaders, were interviewed, some several times, in order to quantify and cross-verify expert statements. Data collection took place during three research stays in Johannesburg between 2012 and 2014, following a preliminary study undertaken in 2011.

The interviews lasted between 20 min and 2.5 h. They provided insights on the political intentions and practical reasons for priority setting and the underlying motivations to address climate change issues (e.g. via synergist responses) and captured experts' subjective explanations of adaptation barriers. Planning documents reveal political adaptation objectives—both explicit and implicit—their (rhetorical) linkage with sustainable urban development issues in Johannesburg, and their translation into programmes and projects. Planning documents considered in the analysis included the development planning frameworks as well as budgeting documents—including the City of Johannesburg's (CoJ, in the following 'the city') internal *Capital Infrastructure Management System* (CIMS)—political speeches, and press statements. In addition, access to the city's GIS-based planning database was granted by the city. It provides information on spatial development areas, spatial programme framings, and approved land use change and development applications.

Contexts of urban climate adaptation: the Johannesburg case

There is a strong political commitment to fundamentally revise current planning policy and practices in order to promote a more resilient, sustainable, and liveable city in Johannesburg (CoJ 2011b; Tau 2013; Fauwler 2013). This potentially opens opportunities to reform planning practices that otherwise contribute to climate change risks and vulnerabilities. A key urban agenda to facilitate this at a strategic level is the city's long-term development agenda, the Joburg 2040 strategy. It links and attempts to balance not only growth and social development objectives, but as well different sustainability agendas, including environmental sustainability and climate change issues, in an integrated and holistic manner. Joburg 2040 serves as the guiding strategy for the operational integrated development plans. Providing the central frame of reference for planning practices in Johannesburg, Joburg 2014 determines the *strategic* response space for any adaptation practices.

This orientation of Joburg 2040 "emerge[s] in the context of climate change and natural resource scarcity" (CoJ 2011: 3) and is to promote sustainable and resilient development, including climate adaptation. The city is beginning to experience the ecological limits of current urban development paths that are connected with but not exclusively shaped by climate change (e.g. the risk of drinking water shortages—WSP 2009). Additionally, Johannesburg is prone to various environmental risks, in particular flood risks caused by heavy precipitation events, which in the case of climate change events are projected to further increase in magnitude and frequency (WSP 2009). Although, due to its location, in international comparison Johannesburg is not particularly prone to large environmental disasters, urban flooding already occurs frequently. Its cumulative effects pose significant threats to infrastructure, properties, and the health and life of the urban population, particularly in marginalised areas (WSP 2009; Planner A—2012). Thus, improved disaster preparedness is an adaptation target in urban planning (CoJ 2013). This includes the aims of utilising ecosystem functions to minimise the impact of flooding (CoJ 2011a) and improving hard stormwater infrastructure to exploit the sizeable remaining potential to reduce flooding vulnerability and risks.

Despite the well-recorded history of urban floods and climate change projections, the flood risks of climate change, in its *current* effects, do not over-dominate other

planning challenges in Johannesburg. Instead, Johannesburg provides an extreme case of the context condition of urban divide. With a Gini-coefficient of 0.75 (UN-Habitat 2010: 1/73), it is characterised by high social inequalities and spatial disparities in the quality and availability of services, infrastructure provision, and housing options found in the prosperous and the marginalised areas (Murray 2011). Large service and infrastructure backlogs in the townships were inherited from Apartheid planning. They are perpetuated by social exclusion mechanisms in the increasingly globalised post-apartheid city today[1] and pose an important political concern in Johannesburg (Tau 2012). Planners are confronted by society's entrenched expectation of correcting urban inequalities, which, despite its link to today's socio-economic dynamics, remain tied to apartheid restitution demands (Hetz and Bruns 2014). Hopes for the immediate betterment of living conditions were high after apartheid, but despite impressive service delivery programmes, they remain unmet for many, in particular black Africans in Johannesburg (Tau 2012). Accordingly, there is political pressure to meet these expectations.

This situation of a high level of urban divide translates into the twin planning tasks of promoting urban economic growth in 'world class' urban areas of Johannesburg and addressing socio-spatial disparities, e.g. by service and infrastructure interventions in marginalised areas. In Johannesburg, the operational response space for climate adaptation is likely to be determined by the ways adaptation practices can be synergised with the pressing planning challenges of urban divide, and how, accordingly, adaptation practices gain political legitimisation in reference to society's expectations about planning outcomes. These are shaped by hopes for a rapid improvement in living conditions in the marginalised areas following the country's political liberation.

Tracing synergistic planning practices

Signposts for adaptation synergies: Johannesburg's planning priorities

Before paying attention to specific projects and programmes, the city's planning priorities are examined. They constitute a link between the rather broad strategic agenda and the implementable planning projects and programmes. Johannesburg's planning priorities are part of the integrated development plan (IPD) and encompass three thematic aspects (CoJ 2013: 49):

- the potential of a programme or project to promote urban economic growth, to 'respond to immediate challenges or business requirements' and to target related 'key enablers' (e.g. infrastructure systems),
- a programme's or project's contribution to poverty and inequality reduction, which is linked to inclusive job creation, and
- the contribution of a programme or project to facilitate spatial transformation, which links to both the development of a more economically and resource efficient urban fabric (including the focusing of infrastructure intervention in economic growth areas) and to rectify socio-spatial inequalities inherited from Apartheid.

Besides, planning projects or programmes offering cross-sectoral benefits should be promoted (ibid.). Despite the commitment to urban sustainability and climate resilience expressed in Joburg 2040, the climate change responsiveness of planning programmes is *not* a priority criterion. This underlines the necessity of realising synergistic adaptation responses in order to realise the city's climate change adaptation objectives.

The IDP includes further priority criteria, such as the 'readiness' of a programme or its 'iconic character' (CoJ 2013: 49). The first is motivated by the aim of delivering planning outcomes quickly. The second is to foster the implementation of projects that produce highly visible and marketable outcomes. Tendencies towards preferring timely finalised (cp. short-termism argument introduced earlier) and iconic planning projects are an urban governance trend observed worldwide. In particular, it has been described in situations in which government is overburdened and thus unable to tackle heterogeneous issues or expectations, but at the same time urged to demonstrate an ability to act. While in the German case, for instance, such a trend has been explained primarily by politicians' interests in being re-elected (Häußermann et al. 2008), the realisation of planning responses that bring visible and immediate benefits to the lives of populations in marginalised areas is crucial to maintaining social peace in Johannesburg (Hetz and Bruns 2014). Accordingly, there is a consensus amongst planners—clearly reflected in the IDP—that prior to tackling longer-term issues, the city must first address immediate development challenges, that is 'to get the basics right' (CoJ 2013: 47). This prioritisation may significantly disadvantage the implementation of planning projects and programmes that have longer-term benefits or less visible or obvious development effects.

Adaptation synergies?: Stormwater challenges and planning responses

To investigate the realisation of synergistic adaptation responses in-depth in planning practices in Johannesburg,

[1] Consequently, South African slums, for instance, are being interpreted as a phenomenon that is here to stay (Huchzermeyer 2011).

this section draws attention to land use and infrastructural planning practices towards stormwater challenges. The related flood risks are being ranked as the most severe climate risk in Johannesburg. There is considerable potential to reduce flood risks and vulnerability through the modification of current land use and stormwater infrastructure practices.

Improved wetland protection as a means of managing flood risks of climate change

The Johannesburg metropolitan area contains large hill slope seepage and valley bottom wetlands. Wetlands provide flood regulation functions and can cope better with rainfall variability than hard stormwater infrastructure (MA 2005; Sharma and Kansal 2013). As green open spaces, they provide co-benefits for Johannesburg's 'liveable city' objective and for economic growth objectives. Utilised for recreational purposes, green open spaces can improve Johannesburg's attractiveness for high-skilled human capital. Conversely, after development, former wetlands potentially constitute areas prone to flooding. According to planning guidelines, wetlands must be preserved in Johannesburg (CoJ 2009). In the past, however, numerous wetlands were not captured in wetland delineation studies and hence made available for development (ibid.). In view of climate change, improved wetland preservation—in the framework of the utilisation of "natural systems to minimise the impact of flooding"—is suggested as a proactive flood risk management strategy that links to climate adaptation objectives (CoJ 2011b: 39, planner B—2014).

Developments require environmental authorisation, which can be granted by provincial government when developments take place outside wetland areas. Wetland delineation studies are supplied by the developer. The city's *Environment and Infrastructure Services Department* (EISD) is mandated with monitoring environmental compliance of land uses. Since 2009, the city is obliged by national legislation to map sensitive environmental sites and classify them into different protection categories in order to develop baseline data to inform decisions concerning land use changes. The motivation is the protection of South Africa's biodiversity (CoJ 2011a). Due to overlaps between wetlands with high levels of biodiversity and these mapped ecological sensitive sites, called *Bioregional Plan* (BRP) areas, the introduction of this legislation provides the city with the possibility to improve the protection of some wetlands. In addition to the BRP areas, the EISD has mapped *all* wetland areas on its own initiative, under the city's *Wetland Audit* (CoJ 2009). This is to better control whether existing wetlands are indeed included in wetland delineation studies, and, taking this into consideration, if environmental authorisation for developments is granted correctly. However, both programmes are not being implemented as initially intended. The Wetland Audit lacks any prescriptive force since sufficient political support to convert the audit into a policy has not yet been achieved. Similarly, digital maps of BRP areas are available to planners, but as yet they are not been included in the integrated development plan. They, too, lack any policy character. I will later demonstrate that, consequently, urban development continues to take place in sensitive ecological areas, including wetlands, in Johannesburg.

Addressing capacity constraints of the stormwater drainage system

When wetlands disappear, the necessity of depending on hard stormwater infrastructure increases. Thereby, planners are aware that climate change will have an additional impact on existing stormwater drainage and attenuation infrastructure (CoJ 2011b). As in many other metropolitan cities in the Global South, stormwater infrastructure is in poor condition in Johannesburg. Extensive drainage capacity constraints, aged components, and more than 200 severe defects of drainages and dams are documented (planner C—2013; planner B—2013; CoJ 2012a: 26). Additionally, various urban communities lack any stormwater drainage or attenuation, either due to informal development or the government's failure to provide it during the development of its give-away housing settlements.

A planning-linked rational process for allocating capital budgets in Johannesburg, called *Capital Investment Management System* (CIMS), has been established to ensure the most effective capital budget allocation in situations where capital budget requirements far exceed the municipality's financial means. Usually, the urban developer supplies stormwater infrastructure. However, municipal capital budgets are required to repair, upgrade, and refurbish existing stormwater systems and when the state itself acts as the developer, as it must then supply the infrastructure. The latter is the case in give-away housing projects. In the CIMS, capital budget requirements of proposed infrastructure programmes and projects are ranked. The higher the rank, the stronger the recommendation for a programme and project to receive capital budget in the respective budget year. Due to financial constraints, low-ranked programmes are likely to receive no budget. The ranking criteria are drawn from the planning priorities that were introduced earlier and in view of physical capacity constraints of infrastructure systems, including stormwater. The consideration of capacity constraints has been an advancement in CIMS over the past few years. It is an important step towards specifically addressing environmental risks via infrastructure planning. As well, it

provides opportunities to link stormwater programmes with other programmes and development objectives, and thereby realise synergies in planning practices. In 2012, Johannesburg's mayor announced the approval of a 100 billion ZAR (approx. 7 billion €) budget for infrastructure interventions over the next 10 years (Tau 2012). This represents a tremendous increase in available municipal budgets. Hence, suddenly, there was a promising funding opportunity for those infrastructure projects, including stormwater projects, which due to financial constraints were not realised previously.

The *Johannesburg Roads Agency* (JRA), a municipally owned entity, is the government agency responsible for carrying out stormwater infrastructure programmes and projects in Johannesburg. Immediately after the mayor's budget announcement, the JRA received 737.3 mill ZAR capital budget, which implies a 269 % annual increase (JRA 2013: 55). However, the largest share of JRA's capital budget remains concentrated on road infrastructure programmes (CIMS 06/2013), whereas stormwater projects continue to gather insufficient attention during the capital budget allocation. Besides, mainly *emergency* stormwater projects receive additional capital budget. These projects include repairs of stormwater infrastructure that is *presently* prone to severe failure or which pose *immediate* life threats (e.g. people drowning in open channels). The capital budget for stormwater projects that address further upgrading or repairing work increased only marginally. Within the stated timeframe, for instance, it only rose from 11 mill to 18 mill. ZAR, while the capital budget for emergency stormwater projects, however, increased from 29 mill to 100 mill ZAR (CIMS 06/2013). The mid-term budget reveals that JRA continues to profit from capital budget increases (1453 mill ZAR in 2014/15; 2343 mill ZAR in 2015/16), but that there are no significant changes in the stormwater budget. Currently, a gap of about 500 mill. ZAR capital budget for the proposed stormwater projects exists. Since numerous stormwater infrastructure defects and capacity constraints are not addressed in the proposed projects, the real gap may be significantly larger.

One roads programme offered an interesting synergy opportunity between socio-spatial integration and adaptation objectives. In the framework of converting gravel roads into tarred roads in selected townships,[2] initial stormwater drains are being provided. The target townships are characterised by stormwater capacity constraints which can be addressed accordingly (Planner C—2014). Still, stormwater infrastructure has not been adjusted to actual and anticipated capacity requirements in view of urban densification and the likely increase in heavy rainfall events due to climate change in *any* of the projects addressing stormwater infrastructure, including the roads planning programme.

Limited operational response space: sketching political realities to constrain synergistic practices

Based on the observation that planning practices are substantially limited to a few reactive responses to risk situations under current climatic conditions, in this section I unpack factors that contextualise the described practices as a result of the significantly limited response space of adaptation practices. This section investigates how the response space for synergistic is shaped by political challenges to reconciling adaptive practices to address pre-existing development challenges of urban divide and associated social and economic risks. And it explores the extent to which this limits adaptation synergies in urban planning in Johannesburg.

Government planning priorities

Wetlands protection responses

Various planning actors stated that environmentally sensitive areas overlap with some of the city's strategic development sites. It has hence become an issue of political negotiation to determine the final shape of the BRP areas. This process postpones the frameworks' advancement into a binding municipal policy.

In anticipation of successful economic growth promotion and consequent in-migration, Johannesburg's population is projected to double between 2010 and 2040 (CoJ 2011b: 14). The city estimated that over 950.000 additional residential units are needed within the next 20 years (CoJ 2012b: 44). Accordingly, large vacant sites are required for housing in the near term, of which Johannesburg is increasingly running out (planner D—2013; planner E—2013). At the same time, the predominant urban design in Johannesburg is characterised by low-densities that translate into a large spatial footprint. To accommodate the anticipated low-density expansion, various areas, which include ecologically sensitive sites, were identified as infill areas in Johannesburg's scenario-based *Sustainable Human Settlement Urbanisation Plan* (SHSUP) (CoJ 2012b).

The 'corridors of freedom' is a planning concept to promote urban compaction and densification in Johannesburg (CoJ 2014). This could help limit greenfield developments, e.g. in ecologically sensitive sites. Recent development patterns, however, indicate that the concept's objectives and actual urban development continue to

[2] The 'gravel roads programme' is being implemented in seven townships in Johannesburg. In the 2013/2014 budget year, it received a share of 22.5 % of JRA's capital budget (JRA 2013: 56).

diverge. Analysis of the city's approved development and land use change applications confirm planners' statements that some of Johannesburg's ecologically sensitive areas, including wetlands, are currently being made available for predominantly low-density development. Two prominent recent examples are housing projects that are part of the private Waterfall City development and the Tanganani government housing project in northern Johannesburg (planner F—2013; planner B—2013; planner G—2014). Both project areas are listed as strategic housing sites in the SHSUP. Examples such as these demonstrate that in their recent spatial outline, the wetland protection programmes result in legal non-compliance for some strategic housing developments in Johannesburg. They are in conflict with the predominant urban expansion pattern that appears to be difficult to change. For the time being, these land use outcomes are 'tolerated' as a side effect of economic growth. Consequently, potential synergies between the densification targets of the 'corridors of freedom' concept and wetland protection cannot be realised.

Infrastructural stormwater responses

A planner centrally involved in the budgeting process in Johannesburg indicated that stormwater projects of the JRA would score relatively high in the CIMS ranking (planner H—2013). Afterwards, however, the ranking would be subject to political renegotiations about the final capital budget allocation (ibid.). During these renegotiations, infrastructural stormwater projects have not yet received the required political support, and hence continue to lack required capital budget approvals.

Johannesburg has experienced years of under-investment in growth supportive infrastructure systems, with the result that today they are alarmingly under-maintained and of insufficient capacity (planner I—2013). Tremendous water losses, severe road damages, frequent electricity outages, and traffic congestion are some of its negative consequences that have started to jeopardise the achievement of economic growth objectives. Hence, "there has been a [political] recognition that we need to invest in our existing infrastructure systems, to replace them and not allow them to collapse and decay anymore" (planner J—2013). The priority of infrastructure programmes is to target those infrastructure systems that are required to support economic growth in the city. Stormwater infrastructure is not a priority. There arguably are synergies between stormwater projects and economic growth objectives, such as the reduction in damages of strategic infrastructure through improved stormwater management. Besides repairs of failing system components, this would require adjustments of stormwater drainage and storage capacity in anticipation of densification and changes in rainfall patterns in order to better manage run-off in the future. Such interventions, however, imply opportunity costs hence trade-offs with those infrastructure systems that are required to promote economic growth. In view of concerns about national economic performance and the belief in economic growth as a key vehicle to reduce socio-spatial disparities, stormwater programmes that receive capital budget support are mainly those that are immediately necessary to prevent severe infrastructure failure or where a risk situation has already escalated (planner C—2013).

The pressure to attend to growth support infrastructure first is also rooted in the fact that not meeting economic growth objectives and realising a speedy improvement of living conditions, particularly for those who have been disadvantaged during apartheid, implies both negative economic implications nationally and high societal risks: In Johannesburg, as throughout South Africa, sporadic violent protests occur frequently and demonstrate the people's deep frustration over the limited improvement in living conditions after apartheid (planner I—2013). Such acts of frustration increasingly pose a threat to social peace in the divided city (Hetz and Bruns 2014). The consequences of not meeting communities' development expectations (e.g. of service delivery) are ranked a most urgent risk in Johannesburg to which environmental risks of climate change, including stormwater related flood risks, are being subordinated (CoJ 2013). In addition, Johannesburg is one of South Africa's major economic hubs. Hence, economic growth generation in Johannesburg is a national development concern, to which planning actors are insistently expected to respond through infrastructural programmes (planner J—2013).

Communities' delivery expectations

Both the utilisation of green spaces, including wetlands, for settlement purposes, and the selective capital budget support of few re-active stormwater projects appear to be in line with service delivery expectations—at least concerning give-away housing practices in Johannesburg's townships. As stated by Hetz and Bruns (2014), there is an entrenched expectation of ultimately profiting from the allocation of a give-away house for access to which a large group of Johannesburg's growing population in informal dwellings legally qualifies. In situations of structural poverty, receiving a give-away house implies being granted economic benefits in the form of land and property ownership, which people are unlikely to receive via their own means and which has considerable positive impacts on living conditions. These observations are relevant for this study, as contrarily, investments in public infrastructure, including stormwater facilities, do not provide such direct

economic benefits. A planner, managing an extensive urban upgrading programme in Johannesburg, admits that hence it is difficult to gain communities' support for wider public infrastructural projects in the townships and adds,

> When we have a community meeting on housing issues, the room is packed. If we call for a meeting, say for a park or something else, almost nobody shows up. […] We even had occurrences where people toitoi-ed [protested] because they wanted us to rather build them houses. (planner K – 2013)

In the case of stormwater projects, communities would complain that capital budgets are not focussed on housing provision instead (planner L—2013). At the same time wetland protection remains difficult as planners are increasingly used to utilise as much space as possible for give-away houses given their established low-density design and land availability problems: In many housing projects, the number of housing qualifiers in a community far exceeds the number of houses that can be provided on an available development site (planner K—2013). This substantially complicates the preservation of green open spaces, including patches of wetlands, within the development areas (planner B—2013, planner F—2014).[3] This example suggests that there are cases where communities' demand for "climate security goods" (Fankhauser and McDermott 2014) are reduced to fixes for alarming risk situations under current climatic conditions. Combined with the municipality's financial complications, the political reality of entrenched expectations of housing delivery leaves limited room to initiate more extensive stormwater upgrades in Johannesburg's townships, which, paradoxically, encompass the areas the most prone to floods (EMS 2011).

Conclusion

This in-depth study explores the political response space for the realisation of adaptation synergies using urban planning practices towards stormwater challenges in Johannesburg, a metropolitan city in the Global South, as an illustrative case. In Johannesburg, risks of urban flooding are shaped by uncontrolled stormwater run-off and discharge during heavy precipitation events that occur frequently and are projected to increase in frequency and magnitude as the result of climate change.

The conceptual arguments to support adaptation synergies are compelling, particularly in the context of the Global South. However, the extent to which synergistic adaptation options are actually possible in planning practices has yet been insufficiently explored. In the highly divided and developing city of Johannesburg, an interplay of contextual conditions and the need to prioritise planning responses in terms of the thematic scale (a high number of urban development challenges) and the temporal scale (many of them being urgent) limit the response space for synergistic adaptation. Although long-term issues are raised at the strategic level, including climate change adaptation, there is political pressure to attend to the most urgent and immediate development issues first. The implicit social and political risks of not meeting post-liberation developmental expectations within defined electoral cycles further entrench the emphasis on meeting urgent short-term needs. As such, the findings from Johannesburg support earlier observations of short-termism in the governing of cities in the Global South (Parnell et al. 2007; Roberts 2010; Ziervogel and Parnell 2014)—at least at the implementation level. The findings also highlight the potential relevance of the 'readiness' argument (Bai 2007) for synergistic adaptation.

In Johannesburg, responses to stormwater related flood risks are significantly limited to coping mechanisms under current climatic conditions. Only the climate change concerns that are most clearly linked with immediate and presently experienced environmental risks are currently being addressed. Scenarios of urbanisation and changing climate conditions are not taken into consideration sufficiently in the examined budgeting and land use practices. This is due to implied opportunity costs as well as conflicting land use requirements in the short term. It was also observed that planning responses to the most urgent stormwater related flood risks are undertaken as an add-on and not in synergy with development priorities. Some synergies between coping and development responses were realised in Johannesburg though, such as the conversion of gravel roads that includes the provision of basic stormwater drains in areas with insufficient stormwater infrastructure and relatively high flood risks.

Given the multiple demands on cities and the fact that prioritisation processes are necessary, this study raises the question to what extent a limited response space for adaptation synergies in planning practices is the result of a lack of synergies or a prioritisation issue. The prioritisation of immediate development issues and the most pressing environmental risks, which is observed in Johannesburg, could be explained by the intrinsic planning problem that the interests of future generations are largely unrepresented

[3] Providing formal shelter for informal dwellers is a legitimate planning response to reduce exposure to environmental risks of climate change, including flooding (Satterthwaite et al. 2009). However, this is certainly not a sustainable response if these houses itself are placed in flood retaining wetlands or in areas of insufficient stormwater drainage capacities. In Johannesburg, insufficient drainage capacity and inappropriately located give-away houses are a reason for frequent flood damages (planner M—2013).

in planning processes (Hurlimann and March 2012: 484). In democracies such as South Africa, for example, it is the current, not the future electorate that places political pressure on the government. Political response space for climate change adaptation, including through synergies, is likely to be altered only by strong societal mobilisation around environmental agendas.

Overall, the study offers insights into the political realities that shape the response space for adaptation, including synergistic adaptation, in Johannesburg, a highly divided city in the Global South. The insights into the extent to which adaptation synergies are politically possible in Johannesburg may be of value for broader investigations how contextual conditions and related multiple demands on cities shape the response space for synergistic adaptation in the Global South. The Johannesburg case suggests that the actual potential for synergies may be far smaller in practice than suggested by conceptual argumentation. If this is verified in further studies, it will be necessary to adjust elements of the conceptual argument around adaptation synergies and the related policy advice. Consequently, the study clearly underlines the initial claim that greater attention must be given to the empirics of actual adaptation synergies.

Acknowledgments This research has been partly funded by the German Federal Ministry of Education and Research (BMBF) under the funding reference number 01 LN 1316 A. I like to thank Antje Bruns and Philip Harrison as well as two anonymous reviewers for their helpful comments and suggestions.

References

Adger WN, Huq S, Brown K et al (2003) Adaptation to climate change in the developing world. Progr Dev Stud 3(3):179–195

Adger W, Dessai S, Goulden M et al (2009) Are there social limits to adaptation to climate change? Clim Change 93:335–354

Bai X (2007) Integrating global environmental concerns into urban management. The scale and readiness arguments. J Ind Ecol 11(2):15–29

Belkin A, Blight J (1991) Triangular mutual security: why the Cuban missile crisis matters in a world beyond the cold war. Polit Psychol 12(4):727–745

Bicknell J, Dodman D, Satterthwaite D (eds) (2009) Adapting cities to climate change. Understanding and addressing the development challenges. Earthscan, London

Biesbroek GR, Klostermann JEM, Termeer CJAM, Kabat P (2013) On the nature of barriers to climate change adaptation. Reg Environ Change 13(5):1119–1129

Birkmann J (2011) First- and second-order adaptation to natural hazards and extreme events in the context of climate change. Nat Hazards 58(2):811–840

Birkmann J, Fleischhauer M (2009) Anpassungsstrategien der Raumentwicklung an den Klimawandel: "Climate Proofing". Raumforschung und Raumordnung 2:114–127

Bulkeley H (2010) Cities and the governing of climate change. Annu Rev Environ Resour 35(1):229–253

Carpenter SR, Brock WA (2008) Adaptive capacity and traps. E&S 13(2). http://www.ecologyandsociety.org/vol13/iss2/art40/

Dupuis J, Knoepfel P (2011) Les barrières à la mise en œuvre des politiques d'adaptation au changement climatique: le cas de la Suisse. Swiss Pol Sci Rev 17(2):188–219

Dupuis J, Knoepfel P (2013) The adaptation policy paradox: the implementation deficit of policies framed as climate change adaptation. E&S 18(4):31. doi:10.5751/ES-05965-180431

Eisenack K, Moser SC, Hoffmann E et al (2014) Explaining and overcoming barriers to climate change adaptation. Nat Clim Change 4(10):867–872

Fankhauser S, McDermott TKJ (2014) Understanding the adaptation deficit: why are poor countries more vulnerable to climate events than rich countries? Glob Environ Change 27:9–18

Fürst D (2008) Planung in bürokratischen Organisationen. In: Fürst D (ed) Handbuch Theorien und Methoden der Raum- und Umweltplanung. Dortmund, Rohn, pp 133–160

Haase D, Schwarz N, Strohbach M et al (2012) Synergies, trade-offs, and losses of ecosystem services in urban regions. E&S 17(3):22. doi:10.5751/ES-04853-170322

Häußermann H, Läpple D, Siebel W (2008) Stadtpolitik. Frankfurt a.M, Suhrkamp

Hetz K, Bruns A (2014) Urban planning lock-in: implications for the realization of adaptive options towards climate change risks. Water Intern 39(6):884–900

Holling CS (2001) Understanding the complexity of economic, ecological, and social systems. Ecosystems 4:390–405

Howe C, Suich H, Vira B, Mace GM (2014) Creating win-wins from trade-offs? Ecosystem services for human well-being: a meta-analysis of ecosystem service trade-offs and synergies in the real world. Glob Environ Change 28:263–275

Huchzermeyer M (2011) Cities with slums. From informal settlement eradication to a right to the city in Africa. UCT Press, Cape Town

Huq S, Reid H (2004) Mainstreaming adaptation in development. Inst Dev Stud Bull 35:15–21

Hurlimann AC, March AP (2012) The role of spatial planning in adapting to climate change. Clim Change 3(5):477–488

Hutter G (2007) Strategic planning for long-term flood risk management. Intern Plan Stud 12(3):273–289

IPCC (2014) Climate change 2014: impacts, adaptation, and vulnerability. Part A: global and sectoral aspects. In: Field CB, VR Barros, DJ Dokken, KJ Mach, MD Mastrandrea, TE Bilir, M Chatterjee, KL Ebi, YO Estrada, RC Genova, B Girma, ES Kissel, AN Levy, S MacCracken, PR Mastrandrea, LL White (eds) Contribution of working group II to the fifth assessment report of the intergovernmental panel on climate change. Cambridge University Press, Cambridge, 1132 pp

Kates RW, Travis WR, Wilbanks TJ (2012) Transformational adaptation when incremental adaptations to climate change are insufficient. PNAS 109(19):7156–7161

Klein RJT, Schipper ELF, Dessai S (2005) Integrating mitigation and adaptation into climate and development policy: three research questions. Environ Sci Policy 8:579–588

Macintosh A, Foerster A, McDonald J (2015) Policy design, spatial planning and climate change adaptation: a case study from Australia. JEPM 58(8):1432–1453

Millennium Ecosystem Assessment (MA) (2005) Ecosystems and human wellbeing: wetlands and water. Island Press, Washington

Moser SC, Ekstrom JA (2010) A framework to diagnose barriers to climate change adaptation. Proc Natl Acad Sci 107(51):22026–22031

Murray M (2011) City of extremes. The spatial politics of Johannesburg. Wits University Press, Johannesburg

Parnell S, Simon D, Vogel C (2007) Global environmental change: conceptualising the growing challenge for cities in poor countries. Area 39(3):357–369

Pasquini L, Cowling RM, Ziervogel G (2013) Facing the heat: barriers to mainstreaming climate change adaptation in local government in the Western Cape Province, South Africa. Habitat Int 40:225–232

Pelling M (2011) Adaptation to climate change: from resilience to transformation. Routledge, London

Picketts IM, Déry SJ, Curry JA (2014) Incorporating climate change adaptation into local plans. JEPM 57(7):984–1002

Revi A, Satterthwaite D, Aragon-Durand F et al (2014) Towards transformative adaptation in cities: the IPCC's fifth assessment. Environ Urban 26(1):11–28

Reyer C, Bachinger J, Bloch R et al (2012) Climate change adaptation and sustainable regional development: a case study for the Federal State of Brandenburg, Germany. Reg Environ Change 12(3):523–542

Roberts D (2008) Thinking globally, acting locally: institutionalising climate change at the local government Level in Durban, South Africa. Environ Urban 20(2):521–537

Roberts D (2010) Prioritizing climate change adaptation and local level resilience in Durban, South Africa. Environ Urban 22(2):397–413

Satterthwaite D, Huq S, Reid H et al (2009) Adapting to climate change in urban areas: the possibilities and constrains in low- and middle income nations. In: Bicknell J, Dodman D, Satterthwaite D (eds) Adapting cities to climate change. Earthscan, London, pp 3–51

Schipper L (2007) Climate change adaptation and development: exploring the linkages. Tyndall Centre for Climate Change Research. Working paper 107

Sharma D, Kansal A (2013) Sustainable city: a case study of stormwater management in economically developed urban catchments. In: Luo Z (ed) Mechanism design for sustainability. Springer, Dordrecht, pp 243–263

Sharma D, Tomar S (2010) Mainstreaming climate change adaptation in Indian cities. Environ Urban 22(2):451–465

Smit B, Pilifosova O (2001) Adaptation to climate change in the context of sustainable development and equity. In: McCarthy JJ, Canziani O, Leary NA, Dokken DJ, White KS (eds) Climate Change 2001: Impacts, Adaptation and Vulnerability. IPCC Working Group II. Cambridge University Press, Cambridge, pp 877–912

Tol RSJ (2005) Adaptation and mitigation: trade-offs in substance and methods. Environ Sci Policy 8(6):572–578

Tompkins EL, Adger NW (2003) Building resilience to climate change through adaptive management of natural resources. Tyndall Centre for Climate Change Research. Working paper 27

Uittenbroek C, Janssen-Jansen LB, Runhaar HAC (2013) Mainstreaming climate adaptation into urban planning: overcoming barriers, seizing opportunities and evaluating results in two Dutch case studies. Reg Environ Change 13:399–411

UN-Habitat (2010) State of the world's cities 2010/2011. Bridging the urban divide. Earthscan, London

Wilson E, Piper J (2010) Spatial planning and climate change. Routledge, New York

Yin R (2009) Case study research. Sage, London

Ziervogel G, Parnell S (2014) Tackling barriers to climate change adaptation in South African coastal cities. In: Smith GP, Glavovic BC (eds) Adapting to climate change: lessons from natural hazard planning. Springer, Dordrecht, pp 57–73

Ziervogel G, Shale M, Du M (2010) Climate change adaptation in a developing country context: the case of urban water supply in Cape Town. Clim Dev 2(2):94–110