

# Water, equity and resilience in Southern Africa: future directions for research and practice

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Drawing from the proceedings of an expert workshop with academics, researchers, government and NGO participants working in diverse countries in southern Africa and beyond, this paper reviews the discourse on resilience, both conceptually and in practice. We highlight opportunities to develop and apply a more situated, equity-sensitive and context-relevant understanding of resilience, particularly in the water sector. To pursue more just and resilient water futures in highly unequal and water stressed regions, we propose that researchers and practitioners (1) place greater emphasis on the transformative potential of resilience, (2) broaden the social dimensions of resilience to account more fully for intangible and other social factors, (3) engage critically with the decision-making processes and practices of building resilience, (4) contribute to the development of indicators and guidelines for building just and resilient water futures, (5) strengthen the role of situated knowledges, (6) critically engage with scale and boundaries in complex adaptive systems, and (7) strengthen the policy–science–civil society interface.

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## Introduction

Today, resilience thinking is prolific across a range of research fields and global policy domains, serving as a bridge between social and environmental sciences, and between science, policy, and practice. Resilience, in its broadest sense, refers to the ability of systems or societies to cope with shocks, stresses and change, whether by persisting or by adapting and transforming [1<sup>\*</sup>]. Early work on resilience used the term to describe, or measure, of the ability of systems to absorb change [2] — a notion that has since evolved. Today, resilience thinking is widely used as an approach to deal with complex adaptive systems dynamics and their inherent uncertainty, promoting learning to live with change as an opportunity [1<sup>\*</sup>]. The ability to adapt and transform in the face of change is often considered a key aspect of resilience thinking [1<sup>\*</sup>] at the conceptual level, while in practice the question of what constitutes fundamental change and how to achieve it remains a topic of research and ongoing debates [3]. Another key dimension of resilience thinking is dealing with uncertain risks associated with climate change impacts or other complex system interactions in the Anthropocene and, as such, resilience thinking is often concerned with how societies and biophysical systems can not only persist, but also thrive in the face of disturbance, both anticipated and unknown [cf. 4].

Debates about the conceptual, normative and applied aspects of resilience are ongoing, particularly around how the term has been mainstreamed in development, planning and academic arenas. Despite numerous and

valid critiques [e.g., 5,6<sup>••</sup>,7–10], resilience thinking has been identified as a useful heuristic to guide integrative thinking [8] and as providing a valuable intellectual space in which to embrace complexity in human–environment relations across multiple disciplines [6<sup>••</sup>]. Because of these ongoing debates, the growing use of the term necessitates that we critically reflect on and constructively engage with its various applications. As such, the aim of this paper is to address key concerns related to the diverse existing and future applications of resilience thinking in water governance in southern Africa. This includes crucial focus on social justice, power, and transformation. With this in mind, we suggest new pathways towards more grounded (or situated) and transformative notions of resilience in the context of highly unequal and water-stressed regions.

We engage with the main objectives of resilience thinking as a scientific, applied and political discourse by bringing voices and lessons from various spaces in southern Africa — a water-stressed region with persistently high levels of poverty, inequality, vulnerability, and governance challenges. Southern Africa is prone to increased frequency of extreme climatic events, particularly El Niño-related droughts, exacting a heavy toll on the inhabitants and economies of the region. The water security challenges for this region involve climate change impacts, more frequent droughts, inadequate water infrastructure, rapidly growing population, and water pollution [11–13]. These water-related risks have profound implications for social justice, health, and food and livelihood security as they affect disproportionately poor and marginalized communities.

Building on a 2.5-day expert workshop<sup>11</sup> held in Stellenbosch, South Africa in August 2016, we offer insights about how to move towards an equity-sensitive approach to building water resilience, drawing from the diverse perspectives of experts on water, vulnerability and climate change adaptation, with particular focus on southern Africa. In so doing, we engage with the often highly technical, western-centric and positivist claims behind

<sup>11</sup> This paper synthesizes the work of member of the International WaTERS research consortium ([www.international-waters.org](http://www.international-waters.org)), and partners, who hosted a 2.5 day expert workshop in August 2016 in Stellenbosch, South Africa, to collaborate and share research on water governance and various dimensions of resilience and vulnerability in diverse contexts across southern Africa. Participants included researchers, NGOs collaborators, and government officials, representing 7 countries (Canada, US, South Africa, Malawi, Botswana, Netherlands, India) and a range of disciplines: geography, anthropology, history, engineering, social work, environmental studies, biology, ecology and others. This paper summarizes the main themes raised at this workshop and identifies pathways for future research and practice. To identify these pathways, detailed notes from the workshop were compiled, analyzed by themes, which were then sent around to all participants for further feedback. Further information, participant list and reports available at <http://waterequity.pwias.ubc.ca/>.

resilience and propose a more situated and grounded approach. Together with Eakin *et al.* [14<sup>••</sup>] and Cutter [15<sup>•</sup>], we understand resilience building primarily as a socio-political process. Achieving resilience in a meaningful way hinges on making socio-political processes transparent and legible [16]. We further argue that in managing risks, we need to move away from relying exclusively on risk assessments, to include a deeper engagement with the socio-political influences behind decision-making itself, including culture, knowledges, politics, and power dynamics [cf. 14<sup>••</sup>]. In this vein, we propose that researchers and practitioners (1) place greater emphasis on the transformative potential of resilience, (2) broaden the social dimensions of resilience to account more fully for intangible and other social factors, (3) engage critically with the decision making processes and practices of building resilience, (4) contribute to the development of indicators and guidelines for building just and resilient water futures, (5) strengthen the role of situated knowledges, (6) critically engage with scale and boundaries in complex adaptive systems, and (7) strengthen the policy–science–civil society interface.

### **Water, resilience and equity in southern Africa**

With a growing social science literature on resilience [10,17,69], and the emergence of more specific scholarship on urban resilience [18<sup>••</sup>] and water resilience [19], resilience has become an influential concept in resource planning and governance. Resilience has also become a strategic agenda in the southern African region through major funders, donor agencies and foundations, including the Rockefeller Foundation's 100 Resilient Cities, the UNISDR Resilient Cities preparedness programs, various climate resilience funding schemes, and others. Embedded in complex adaptive systems thinking, the resilience discourse tends to promote diversity, flexibility, inclusion, participation, and recognition of social values as important or desirable for building resilience. However, the links between these principles and resilience outcomes remain less understood. In addition, resilience thinking promotes acceptance of, and coping with, uncertainty and change [20–22,73]. As such, resilience, we believe, holds tremendous potential to promote new forms of adaptive governance — flexible, more inclusive and open to change. However, we find there is a gap in understanding precisely how these diverse resilience objectives are linked. As we see in southern Africa and other contexts, resilience building efforts are further shaped by the interests of different donor agencies or transnational organizations, for example, the Rockefeller Foundation and others, that tend to promote expert-driven top-down approaches.

In the water sector, resilience thinking manifests in various ways — from resilience to specific water-related risks, such as droughts or floods, to resilience of social–ecological systems to various chronic and emerging

hydrologic shocks. Southern Africa is important in this context because it faces high levels of inequality, development challenges of ensuring access to water and sanitation within highly unequal social systems, and high vulnerability to climate change and other stressors [11,23–25]. For instance, in South Africa the Gini coefficient of water inequality is directly correlated with income inequality, which is among the highest in the world [26,27]. The colonial history of the region and powerful economic, political and social interests, have contributed to focus on in techno-centric understanding and approaches to water use — the so-called hydraulic paradigm [27]. As such, applying a resilience-informed agenda in southern Africa requires dealing more centrally with the social justice and equity challenges associated with resilience. Otherwise, it is very likely that the outcomes of resilience building efforts will deepen existing inequalities and destabilize ongoing efforts to build more inclusive and just societies.

In the context of urban water planning, resilience — as constructed by international, or national and local agendas — remains predominantly aligned with techno-centric approaches around risk reduction and risk management, which does not adequately address ongoing development challenges around equitable access to water, gender issues, participatory governance, and legacies of infrastructure and resource inequality. It is therefore of utmost importance to critically interrogate the resilience agenda within the realities of social, economic and political disparities in southern Africa. Below we provide a few ways to rethink and resituate resilience as a pathway towards more equitable, just and sustainable water futures in the region, and beyond.

### Pathways to just and resilient water futures

Because resilience has become a pluralistic discourse [28<sup>•</sup>,29,30] that draws on a multiplicity of epistemologies and approaches, the pathways towards achieving resilience are also multiple. The following section explores insights and suggestions for practices that can help increase resilience in the water sector in a more transformative manner. In line with the above discussion and other authors [e.g., 31<sup>•</sup>] we argue that researchers and practitioners should engage with resilience with a primary focus on equity and justice.

### Rethinking transformation

Resilience has indeed been criticized for being a conservative concept, often interpreted as serving to maintain the status quo [8,9]. Meanwhile, others have pointed out that resilience is fundamentally about dealing with and navigating change, and therefore it is primarily concerned with the capacity to adapt — and transform — in the face of change [20,1<sup>•</sup>,32,73,72]. While transformation is a challenging process [33], we believe that it is critically important to engage with the notion of transformative

capacity, and specifically with questions of ‘towards what’, ‘for whom’ and ‘through what processes’ [cf. 18<sup>••</sup>].

While resilience is often intuitively understood to be an uncontested ‘good’ — or universally beneficial — there is a small but growing body of work that scrutinizes the normative assumptions behind resilience, both as a concept and in practice [8,34]. For example, some critics of resilience have pointed out that undesirable and unequal systems can also be very persistent, or resilient. Further, a large proportion of the resilience-focused work in the global South assumes that due to high levels of vulnerability, lower capacity, or endemic poverty, building resilience is needed, necessary and desirable. This in turn has led to overreliance on external technical expertise aiming at bringing lessons and capacities from other contexts. However, this position undermines the existing sources of adaptive capacity among vulnerable communities as they navigate and cope with high levels of inequality in service provision [35]. In southern Africa, it is precisely high levels of inequality in water access and governance, and therefore inequity in adaptive and transformative capacity, that systematically undermine resilience, both state and community-led, to water-related risks. A more concerted effort by the research, policy and practice communities is needed to identify leverage points that can lead to transformation towards equitable water governance as a necessary means, and an end, to achieving resilience.

In this regard, resilience thinking has received many similar critiques to those of sustainable development. Resilience and sustainability are in fact closely linked, and at times conflated, discourses (e.g., [36,37]) as is evident in the prominent use of the term ‘resilience’ in the SDGs (see <https://sustainabledevelopment.un.org/>). While these concepts are not inherently incompatible with notions of justice and just transformations, resilience thinking tends to focus on biophysical and ecological dynamics more prominently than on societal transformation. We argue for continued critical interrogation of the various aspects of resilience, including transformative capacity, and for questioning whether particular aspects of or pathways to resilience, however defined, benefit society as a whole or whether they reinforce existing inequalities. In contexts such as southern Africa, to strengthen the resilience of societies to water-related shocks will require fundamental change: breaking down structural barriers in the economy and enabling socially transformative forms of governance. In this sense, achieving equity is likely a necessary pathway to achieving resilience.

### Broadening the social dimensions of resilience

While this focus has been growing in the resilience domain, further progress is needed to deepen and broaden understandings of the social dimensions of

resilience. There is a long history of work on the social justice aspects of water governance, development and adaptation studies that can lend useful tools and insights. One possible avenue to engage more meaningfully with how the 'social' is conceptualized in resilience thinking is the Capabilities Approach (CA) [cf. 38,39]. An alternative framework for thinking about well-being, the CA concentrates on the human capabilities or substantive freedoms people value, giving primacy to the ideas of freedom and opportunity, rather than the distribution of material goods. An expanded notion of human wellbeing, associated with the Capabilities Approach [38,40–42], can challenge the way in which we think about social systems and enable new ways of considering the intangible dimensions of resilience, such as emotion, agency and power.

In this sense, resilience could be reframed around the notion of a just society — more so than 'sustainable' society — and the sets of opportunities that such an approach would enable. A 'just society' refers not only to the fair distribution of essential material goods — such as taps and pipes — but also of non-material 'goods', such as the emotions associated with not having access to clean water, safety considerations, or being excluded from decision-making opportunities or other forms of social networks. Resilience in this sense would focus more prominently on notions of agency, gender, justice, equity and more equal relations of power as key factors that enable societies not only to cope, but also to thrive in the face of change. We argue that more equitable societies are more likely to be able cope and adapt in the face of change, as the capacities to learn, self-organize, innovate, and transform are more evenly distributed among different groups, as opposed to concentrated in the hands of a few.

### Engaging with processual dynamics

The processes required to build resilience are critically important and yet often overlooked. As such, we argue that the processes of building resilience are equally important as the outcome. Of course, Biggs *et al.* [43] and many others have already highlighted the importance of governance inclusivity and participation as critical aspects of achieving social–ecological resilience. However, given the ongoing complexities and historical tensions of participatory governance in many contexts, especially southern Africa, we argue for critical unpacking of what 'participatory' and 'inclusive' might mean in different contexts and through what means are they to be achieved. We therefore invite more focus on the processes that guide decision-making and action around resilience. As an example, our workshop discussions elaborated on the idea of resilience as a process of negotiation — a notion that can help attend more fully to the processual dimensions of resilience (for further discussion, see [16]). Given that there is likely no singular

or universally resilient outcome (see also [30]), what might be resilient for some may not be for others, what might be resilient at one scale may not be at others, and what might be resilient in one sector (e.g., water) may not be in others (agriculture or energy).

For example, municipal efforts to build resilience to drought in the currently water-stressed Cape Town, South Africa, will likely involve tapping into the groundwater system in the Cape Flats — an ecologically sensitive area that is also home to some of the biggest informal, peri-urban and impoverished urban areas in Cape Town. Developing groundwater sources involved various trade-offs, including between food security — as groundwater is used for food production — and flood resilience — as the water table in the Cape Flats is very high. This case a prime example of the tradeoffs between local resilience for the communities in the Cape Flats and the resilience of the metropolitan urban water supply systems. In this and other examples we see that complex trade-offs are inherent in the process of resilience building and as such they must be actively, and fairly, negotiated. Such negotiations are necessarily normative and deliberative, creating space to negotiate values, to engage in deliberative decision-making, and to account for, and to recognize, difficult losses that are incurred with trade-offs [44,45]. As such, building resilience needs to move beyond simply engaging communities to more adequately consider and build processes to facilitate transparent and fair negotiation.

### Measuring equity and resilience

We recognize the applied and practical importance of measuring resilience, both in terms of outcomes and process, to help monitor adaptive and transformative capacity — or the ability to cope with and deal with change — over time. While much work is focused on designing generalizable metrics and frameworks for assessing resilience [e.g., 46,47], the specific historical, social, economic, political and biophysical characteristics of different locales require more grounded and context-sensitive approaches. There are ongoing debates in the resilience scholarship about how precisely to measure resilience [see 46–48] including water-related resilience [e.g., 49]. However, the emerging consensus is that it is unlikely that a unifying metric of resilience will be developed. Instead, tracing or measuring water resilience will require a suite of metrics, drawing from various fields and capturing various scales. Metrics should capture both outcome and process specific indicators, and include common systems level metrics (e.g., water storage; overall water use) at various spatial scales. Metrics of water resilience should also involve more diverse indicators to capture the complex dimensions of social systems.

Further, we would like to highlight the importance of including equity indicators that can help empirically track

the relationship between equity and resilience — a persistent gap in the empirical work on resilience. Efforts to measure resilience should include various metrics of equity, for example, the Gini index of household water use, in ways that are attentive to local realities of inequality and their spatial manifestations (cf. [35]), which in turn shape differentiated resilience and capacity to cope with water-related risks. Furthermore, indicators should be meaningful to diverse stakeholders, including impacted groups and decisions makers, and should thus be developed and adopted through participatory processes. As such, the very process of coming up with water resilience metrics could be an advance in procedural equity, particularly to the degree that defining such an effort is transparent, participatory and accessible. One promising example is the process of coming up with the Durban/eTwekini's Resilience Strategy, which involved iterative and participatory processes at all stages of formulating the city's Resilience Strategy, with explicit focus on representation and inclusion from the most marginalized groups.<sup>12</sup>

### The role of situated knowledge(s)

Resilience scholarship, particularly in the domain of social–ecological systems, has indeed recognized the value of traditional ecological knowledge in understanding processes of change [see 50,21]. And yet, much of the work on urban resilience and climate resilience today tends to be predominantly forward-looking, often neglecting to integrate lessons from historic examples or to consider historical factors as sources of vulnerability. For example, the colonial legacies of southern Africa have historically silenced the voices of subsets of African populations, resulting in the loss of insights into creative forms of coping strategies in building resilience to droughts, floods or other water-related risks. The oral nature of this history has also meant that these adaptive strategies need to be revealed through dialogue and story-telling, as it exists in the experiences, histories and voices of the people, rather than written documents. As noted above, many people in impoverished communities live very 'resilient' lives, coping on a daily basis with shocks and lack of services or basic infrastructure. Greater attention thus needs to be paid to the wealth of experience, knowledge, and capacity that exists, and that has existed in these contexts.

As many historians would attest, the growth of societies has been accompanied by constant practices of adapting to changing stresses and opportunities [51]. Parallels can also be drawn from work in the transitions literature that studies processes of societal change over time (e.g., [52]).

<sup>12</sup> See more at: [http://www.durban.gov.za/City\\_Services/development\\_planning\\_management/environmental\\_planning\\_climate\\_protection/About%20Durban%E2%80%99s%20Resilience%20Programm/Pages/Durban%E2%80%99s-Resilience-Strategy.aspx](http://www.durban.gov.za/City_Services/development_planning_management/environmental_planning_climate_protection/About%20Durban%E2%80%99s%20Resilience%20Programm/Pages/Durban%E2%80%99s-Resilience-Strategy.aspx).

Understanding how past societies in specific places succeeded or failed in adapting to past climatic or hydrologic variability, for example, may very well provide us with a deeper insight into specific capacities that helped (or did not) in dealing with environmental or climatic exigencies. As such, revisiting the work of [50,53] we believe experiential and grounded — or situated — knowledges deserve deeper engagement and a more prominent place in other domains of resilience, such as urban resilience or water resilience.

Further, we find it is important to challenge the nature of 'knowledge' in resilience building, particularly whose knowledge and expertise is being incorporated. As [54] and others have observed, there are profound challenges in integrating scientific, policy-relevant and civil society perspectives, including questions of credibility and legitimacy of different forms of knowledge. Specifically, in southern Africa, there is a high diversity of cultures and knowledge systems that need to be considered, particularly when such knowledges are difficult to integrate within in the highly technical and bureaucratic language of resilience building [54]. Together with these authors, we argue for more attention to the processes of knowledge generation and the politics of knowledge production in the efforts to build resilience in the global South and beyond.

### Embracing and navigating hydrologic change in complex systems

Among the main conceptual foundations of resilience are the notions of change and complexity [e.g., 55,56]. As such, resilience thinking often highlights the need to better understand and learn how to navigate change and complex interactions (and trade-offs) between various factors, such as climate change, socio-political change, global environmental change, endemic poverty and inequality across various temporal and spatial scales. Specifically, in the context of water management, Pahl-Wostl *et al.* [57], Lee-Moore [58] and others have argued for explicitly engaging with the complex and unpredictable nature of change in water systems, by focusing on learning and adaptive processes, rather than solely on outcome-based planning. Dunn *et al.* [59] have further argued for a shift towards complexity thinking in water governance, that accounts for the highly variable and increasingly unpredictable nature of hydro-social dynamics. As such, many have argued for a shift towards radically different notions of water governance that are more adaptive, flexible and context-sensitive [60]. However, there is still little understanding of how to apply the resilience-informed principles of flexibility, adaptiveness and transformability to the water sector, where there is a historical prevalence of hard physical infrastructures that are not always easy to change. Insights and starting points have been suggested in work that is increasingly promoting flexible, or soft infrastructure approaches, such as

using urban river corridors and wetlands and stormwater conduits or for flood retention (e.g., [61] or work on adaptive water law that can incorporate notions of uncertainty [62]).

Further, while complexity thinking is an emerging approach within water governance, there is a strong need to understand how processes of change, both biophysical and social, interact across scales. This calls for a critical engagement with the notions of scale, specifically recognizing that in social systems, scale is often inherently political, and social processes often prioritize certain scales or spaces over others, sidelining and obscuring other processes [cf. 63]. Applying concepts such as complexity and scale — which have strong roots in systems thinking and the natural sciences — to social systems without critical reflection can result in misaligned understandings of the actual drivers, or outcomes, of resilience. As such, we believe that the application of resilience thinking to water risks in the context of southern Africa, or in other contexts, requires critical thinking about how scale and boundaries are framed and by whom, and what is being enabled or lost by building resilience at different scales.

#### **Resilience in practice: improving the policy–science–civil society interface**

Last, but not least, while resilience thinking necessitates stronger integration across the communities of research and practice, these efforts remain tentative, localized, and often insufficient. As Ziervogel *et al.* [64] argue, there is a need to shift knowledge-policy dialogues away from a one-directional approach where science informs policy, to one where scientific knowledge, managerial knowledge and local (or situated) knowledges all form part of the science-knowledge-policy co-construction process. Indeed, there are many positive signs from projects in southern Africa that have developed linkages between scientists, policy makers and civil society. Examples include the Challenge Programme for Water and Food, the Water Dialogues, the Durban Resilience Strategy and others [65].

Depending on the balance between various actors, these processes can result in scientifically-sound and community-sensitive policy, where communities are able to make decisions with a fuller understanding of localized projections of hydrologic impacts of climate change, and scientists have an improved understanding of the practical uses and needs for research [25,67]. Relationships between experts, civil society and policy makers are maintained most effectively through the establishment of knowledge networks, often drawing on social learning and adopting a structure of regular meetings and exchanges [64]. With the involvement of civil society and community members in scientifically-informed decision making, the push for a more meaningful resilience, or

the capacity for transformative change becomes practically achievable.

#### **Conclusion**

In this concept piece, we review recent relevant scholarship on resilience and water governance, with a focus on the context and insights from experiences in southern Africa, to provide pathways to move towards a more situated equity and justice-centered approach to resilience. We find that a regional focus is important in enabling more meaningful engagement with local knowledges, experiences and places. Specific to southern Africa, we find that the discourse of resilience, albeit strategic and highly influential, is not universally applicable and can be highly problematic. However, we see promise in critically engaging with resilience concepts and practices. While some scholars conceptualize resilience as an end goal, we find more value in the concept as a pathway — a means to guide towards defining and moving towards a range of desirable outcomes, both material and non-material, with a focus on critical reflection along the way. We thus propose that we should move away from a techno-centric, end-point oriented notions of resilience, especially in the context of southern Africa and the Global South, towards more process-oriented notions of resilience, as these may be more useful in transitioning towards more sustainable, just and resilient water futures.

We have also stressed that there is also a key link between equity and resilience that needs to be expanded theoretically and empirically. As such, we believe resilience building should be more concerned with the democratization of policy-making and decision-making processes, including a deeper understanding of how citizens engage with these processes. Resilience as a concept is not alone in having high currency while suffering from conceptual and practical ambiguity. We, however, take the stance that the rich cross-disciplinary engagement and conversation around the concept — as a metaphor or an analytical tool — has resulted in several important contributions, both conceptually and in practice. Resilience thinking holds promise for a deeper understanding of the complex interactions between human and natural systems and has the potential to guide transitions to more sustainable water futures. However, without centering equity and justice in these efforts, we believe that little will be achieved.

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## References and recommended reading

Papers of particular interest, published within the period of review, have been highlighted as:

- of special interest
  - of outstanding interest
1. Folke C: **Resilience (republished)**. *Ecol Soc* 2016, **21** <http://dx.doi.org/10.5751/ES-09088-210444>. This piece provides a thorough review of the research to date and the evolving debates within the resilience scholarship conducted by the Resilience Alliance. It highlights the multiplicity of conceptual approaches and the emerging focus on transformation.
  2. Holling CS, Chambers AD: **Resource science: the nurture of an infant**. *BioScience* 1973, **23**:13-20 <http://dx.doi.org/10.2307/1296362>.
  3. Feola G: **Societal transformation in response to global environmental change: a review of emerging concepts**. *Ambio* 2014, **44**:376-390 <http://dx.doi.org/10.1007/s13280-014-0582-z>.
  4. Zaidi RZ, Pelling M: **Institutionally configured risk: assessing urban resilience and disaster risk reduction to heat wave risk in London**. *Urban Studies* 2013:1-16.
  5. Brand FS, Jax K: **Focusing the meaning(s) of resilience: resilience as a descriptive concept and a boundary object**. *Ecol Soc* 2007, **12**.
  6. Olsson L, Jerneck A, Thorén H, Persson J, O'Byrne D: **Why resilience is unappealing to social science: theoretical and empirical investigations of the scientific use of resilience**. *Sci Advan* 2015, **1** <http://dx.doi.org/10.1126/sciadv.1400217> e1400217-e1400217. This piece provides a thorough review of some of the ontological dilemmas in resilience thinking that emerge at the intersection of the social and natural sciences and argues for pluralism drawing on core social science concepts to facilitate integration.
  7. Cote M, Nightingale AJ: **Resilience thinking meets social theory: situating social change in socio-ecological systems (SES) research**. *Progr Hum Geogr* 2012, **36**:475-489 <http://dx.doi.org/10.1177/0309132511425708>.
  8. MacKinnon D, Derickson KD: **From resilience to resourcefulness: a critique of resilience policy and activism**. *Progr Hum Geogr* 2012, **37**:253-270 <http://dx.doi.org/10.1177/0309132512454775>.
  9. Welsh M: **Resilience and responsibility: governing uncertainty in a complex world**. *Geographical J* 2014, **180**:15-26.
  10. Béné C, Newsham A, Davies M, Ulrichs M, Godfrey-Wood R: **Resilience, poverty and development**. *J Int Develop* 2014:1-26 <http://dx.doi.org/10.1002/jid.2992>.
  11. Wlokas HL: **The impacts of climate change on food security and health in Southern Africa**. *J Energy Southern Africa* 2008, **19**.
  12. United Nations Office of the Coordination of the Humanitarian Affairs: *El Niño: Overview of the impact, projected humanitarian needs and response*. 2016. URL: <https://www.humanitarianresponse.info/ru/operations/madagascar/document/el-ni%C3%B1o-overview-impact-projected-humanitarian-needs-and-response-21>.
  13. Green Gazette: *Declaration of Kwazulu Natal Provincial State of Disaster in Terms of the Disaster Management Act 2002*. 2015. URL: [http://www.greengazette.co.za/notices/declaration-of-kwazulu-natal-provincial-state-of-disaster-in-terms-of-the-disaster-management-act-2002-57-2002\\_20141217-KZN-01288-00167](http://www.greengazette.co.za/notices/declaration-of-kwazulu-natal-provincial-state-of-disaster-in-terms-of-the-disaster-management-act-2002-57-2002_20141217-KZN-01288-00167).
  14. Eakin H, Bojórquez-Tapia LA, Janssen MA, Georgescu M, Manuel-Navarete D, Vivoni ER, Escalante AE, Baeza-Castro A, Mazari-Hiriart, Lerner AM: **Opinion: urban resilience efforts must consider social and political forces**. *Proc Natl Acad Sci* 2017, **114**:186-189 <http://dx.doi.org/10.1073/pnas.1620081114>. The authors demonstrate that efforts to integrate sustainability and resilience into urban planning require focus on tools and processes to capture stakeholder preferences, social relations, and political interests; thus showing that building resilience is primarily a socio-political process.
  15. Cutter SL: **Resilience to what? Resilience for whom?** • *Geographical J* 2016 <http://dx.doi.org/10.1111/geoj.12174>. This essay demonstrates the importance of considering the processes of inequality within the resilience discourse, by arguing for a central focus on who is being privileged through resilience building processes.
  16. Harris LM, Chu EK, Ziervogel G: **Negotiated resilience**. *Resilience* 2017:1-19 <http://dx.doi.org/10.1177/0956247816686905>.
  17. Brown K: **Global environmental change I: a social turn for resilience?** *Progr Hum Geogr* 2014, **38**:107-117 <http://dx.doi.org/10.1177/0309132513498837>.
  18. Meerow S, Newell JP: **Urban resilience for whom, what, when, where, and why?** •• *Urban Geogr* 2016:1-21 <http://dx.doi.org/10.1080/02723638.2016.1206395>. This piece argues for increased attention to the politics of resilience thinking by questioning why resilience is good, for whom, and when. It tackles the question of justice and inequality in social systems.
  19. Falkenmark M, Rockstrom J: **Building water resilience in the face of global change: from a blue-only to a green-blue water approach to land-water management**. *J Water Res Plan Manag* 2010, **136**:606-610.
  20. Walker BH, Carpenter SR, Anderies JM, Abel N, Cumming GC, Janssen M, Lebel L, Norberg J, Peterson GD, Pritchard R: **Resilience management in social-ecological systems: a working hypothesis for a participatory approach**. *Conserv Ecol* 2002, **6**:14.
  21. Berkes F, Colding J, Folke C (Eds): *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change*. Cambridge University Press; 2008.
  22. Adger WN, Arnell NW, Tompkins EL: **Successful adaptation to climate change across scales**. *Global Environ Change* 2005, **15**:77-86.
  23. Casale M, Drimie S, Quinlan T, Ziervogel G: **Understanding vulnerability in southern Africa: comparative findings using a multiple-stressor approach in South Africa and Malawi**. *Regional Environ Change* 2010, **10**:157-168.
  24. Muller M: **Urban water security in Africa: the face of climate and development challenges**. *Develop Southern Africa* 2016, **33**:67-80 <http://dx.doi.org/10.1080/0376835X.2015.1113121>.
  25. Galvin M: *Planning for Adaptation: Applying Scientific Climate Change Projections to Local Social Realities*. 2015. Water Research Commission report 2152/1/15. [www.wrc.org.za69www.wrc.org.za](http://www.wrc.org.za69www.wrc.org.za).
  26. Cullis J, van Koopen B: *Applying the Gini Coefficient to Measure Inequality of Water Use in the Olifants River Water Management Area, South Africa*. IWMI International Water Management Institute; 2007:1-26.
  27. Swatuk LA: **A political economy of water in Southern Africa**. *Water Alternatives* 2008, **1**:24-47.
  28. Brown K (Ed): *Resilience, Development and Global Change*. •• Routledge; 2016. This volume demonstrates how resilience thinking has influenced development policies worldwide and argues that resilience in development, albeit with the potential for a paradigm shift, tends to promote 'business as usual' approaches and thus has been implemented in conservative rather than progressive ways.
  29. Simon S, Randalls S: **Geography, ontological politics and the resilient future**. *Dialogues Hum Geogr* 2016, **6**:3-18.

30. Fisher K: **Coordinating and situating resilience multiple**. *Dialog Hum Geogr* 2016, **6**:32-36 <http://dx.doi.org/10.1177/2043820615624066>.
31. Ziervogel G, Pelling M, Cartwright A, Chu E, Deshpande T, Harris LM *et al.*: **Inserting rights and justice into urban resilience: a focus on everyday risk**. *Environ Urban* 2017, **29**:123-138 <http://dx.doi.org/10.1177/0956247816686905>.
- This piece argues for a shift away from infrastructure focus in resilience thinking by considering citizens' rights as the object to be made resilient. The authors suggest that this approach will be more appropriate for the socio-political realities of cities in the Global South.
32. Chapin F, Carpenter SR, Kofinas GP, Folke C, Abel N, Clark WC, Olsson P: **Ecosystem stewardship: sustainability strategies for a rapidly changing planet**. *Trends Ecol Evol* 2009, **25**:241-249.
33. Olsson P, Galaz V, Boonstra WJ: **Sustainability transformations: a resilience perspective**. *Ecol Soc* 2014, **19** <http://dx.doi.org/10.5751/ES-06799-190401>.
34. Kolers A: **Resilience as a political ideal**. *Ethics Policy Environ* 2010, **19**:91-107 <http://dx.doi.org/10.1080/21550085.2016.1173283>.
35. Sutherland C, Scott D, Hordijk M: **Urban water governance for more inclusive development: a reflection on the 'Waterscapes' of Durban, South Africa**. *Eur J Develop Res* 2015, **27**:488-504.
36. Leach M, Rockstrom J, Raskin P, Scoones I, Stirling AC *et al.*: **Transforming innovation for sustainability**. *Ecol Soc* 2012, **17**:art11 <http://dx.doi.org/10.5751/ES-04933-170211>.
37. Li X, Marinova D, Guo X: **Resilience thinking: a renewed system approach for sustainability science**. *Sustain Sci* 2014:1-16 <http://dx.doi.org/10.1007/s11625-014-0274-4>.
38. Sen AK (Ed): *Development as Freedom*. Oxford University Press; 1999.
39. Jepson WE, Budds J, Eichelberger L, Harris LM, Norman E, O'Reilly K *et al.*: **Advancing human capabilities for water security: a relational approach**. *Water Security* 2017, **1**:46-52.
40. Owen G, Goldin J: **Assessing the relationship between youth capabilities and food security: a case study of a rainwater harvesting project in South Africa**. *Water SA* 2015, **41**:541-548.
41. Goldin JA: **Water policy in South Africa: trust and knowledge as obstacles to reform**. *Rev Radical Political Econ* 2010, **42**:195-212.
42. Nussbaum MC (Ed): *Women and Human Development: The Capabilities Approach*. Cambridge University Press; 2001.
43. Biggs R, Schlüter M, Biggs D, Bohensky EL, BurnSilver S, Cundill G, Dakos V, Daw TM, Evans LS, Kotschy K *et al.*: **Toward principles for enhancing the resilience of ecosystem services**. *Annual Rev Environ Resour* 2012, **37**:421-448 <http://dx.doi.org/10.1146/annurev-environ-051211-123836>.
44. Barnett C, Low M (Eds): *Spaces of Democracy: Geographical Perspectives on Citizenship, Participation and Representation*. Routledge; 2004.
45. Innes JE, Booher DE (Eds): *Planning with Complexity: An Introduction to Collaborative Rationality for Public Policy*. Routledge; 2010.
46. Carpenter S, Walker BH, Anderies JM, Abel N: **From metaphor to measurement: resilience of what to what?** *Ecosystems* 2001, **4**:765-781 <http://dx.doi.org/10.1007/s10021-001-0045-9>.
47. Cumming GS, Barnes G, Perz S, Schmink M, Sieving KE, Southworth J, Binford M, Holt RD, Stickler C, Van Holt T: **An exploratory framework for the empirical measurement of resilience**. *Ecosystems* 2005, **8**:975-987 <http://dx.doi.org/10.1007/s10021-005-0129-z>.
48. Suárez M, Gómez-Baggethun E, Benayas J, Tilbury D: **Towards an urban resilience index: a case study in 50 Spanish cities**. *Sustainability* 2016, **8**:774 <http://dx.doi.org/10.3390/su8080774>.
49. Milman A, Short A: **Incorporating resilience into sustainability indicators: an example for the urban water sector**. *Global Environ Change* 2008, **18**:758-767.
50. Berkes F (Ed): *Sacred Ecology*. Routledge; 2012.
51. Gregory PJ, Ingram JSI, Brklacich M: **Climate change and food security**. *Philos Trans R Soc B* 2005, **360**:2139-2148.
52. Loorbach D: **Transition management for sustainable development: a prescriptive, complexity-based governance framework**. *Governance* 2010, **23**:161-183 <http://dx.doi.org/10.4337/9781847200266>.
53. Bohensky EL, Maru Y: **Indigenous knowledge, science, and resilience: what have we learned from a decade of international literature on "integration"?** *Ecol Soc* 2011, **16**:art6 <http://dx.doi.org/10.5751/ES-04342-160406>.
54. Vogel C, Moser SC, Kasperson RE, Dabelko GD: **Linking vulnerability, adaptation, and resilience science to practice: pathways, players, and partnerships**. *Global Environ Change* 2007, **17**:349-364.
55. Levin SA: **Self-organization and the emergence of complexity in ecological systems**. *Am Inst Biol Sci* 2005, **55**:1075-1079 <http://dx.doi.org/10.1641/0006-3568%282005%29055%5B1075%3ASATEOC%5D2.0.CO%3B2>.
56. Folke C, Carpenter S, Elmqvist T, Gunderson L, Holling CS, Walker BH: **Resilience and sustainable development: building adaptive capacity in a world of transformations**. *AMBIO J Hum Environ* 2002, **31**:437-440 <http://dx.doi.org/10.1579/0044-7447-31.5.437>.
57. Pahl-Wostl C, Holtz G, Kastens B, Knieper C: **Analyzing complex water governance regimes: the Management and Transition Framework**. *Environ Sci Policy* 2010, **13**:571-581 <http://dx.doi.org/10.1016/j.envsci.2010.08.006>.
58. Lee-Moore M: **Perspectives of complexity in water governance: local experiences of global trends**. *Water Alternatives* 2013, **6**:487-505.
59. Dunn G, Brown RR, Bos JJ, Bakker K: **Standing on the shoulders of giants: understanding changes in urban water practice through the lens of complexity science**. *Urban Water J* 2016:1-10 <http://dx.doi.org/10.1080/1573062X.2016.1241284>.
60. Gupta J, Pahl-Wostl C, Zondervan R: **"Glocal" water governance: a multi-level challenge in the anthropocene**. *Curr Opin Environ Sustain* 2013, **5**:573-580.
61. Rijke J, Farrelly M, Brown RR, Zevenbergen C: **Configuring transformative governance to enhance resilient urban water systems**. *Environ Sci Policy* 2013, **25**:62-72.
62. Cosens BA, Gunderson LH, Chaffin BC: **The adaptive water governance project: assessing law, resilience and governance in regional socio-ecological water systems facing a changing climate**. *Idaho Law Rev* 2014, **1**:1-29.
63. Cohen A, Bakker K: **The eco-scalar fix: rescaling environmental governance and the politics of ecological boundaries in Alberta, Canada**. *Environ Plan D Soc Space* 2014, **32**:128-146 <http://dx.doi.org/10.1068/d0813>.
64. Ziervogel G, Archer van Garderen E, Price P: **Strengthening the knowledge-policy interface through co-production of a climate adaptation plan: leveraging opportunities in Bergvriev Municipality, South Africa**. *Environ Urban* 2016, **28**:455-474 <http://dx.doi.org/10.3354/cr00804>.
65. Galvin M: *Straight Talk to Strengthen Water Services*. The Water Dialogues-South Africa; 2009. [www.waterdialogues.org/south-africa](http://www.waterdialogues.org/south-africa).
67. Galvin M: **A hot climate for civil society engagement with climate change and water in Durban**. In *Water and Climate*

- Change in Africa: Challenges and Community Initiatives in Durban, Maputo and Nairobi.* Edited by Perkins P. Routledge; 2013.
69. Biermann M, Hillmer-Pegram K, Knapp CN, Hum RE: **Approaching a critical turn? A content analysis of the politics of resilience in key bodies of resilience literature.** *Resilience* 2015, **4**:59-78.
72. Bahadur A, Tanner T: **Transformational resilience thinking: putting people, power and politics at the heart of urban climate resilience.** *Environ Urban* 2014 <http://dx.doi.org/10.1177/0956247814522154>.
73. Folke C, Carpenter SR, Walker BH, Scheffer M, Chapin FS, Rockstrom J: **Resilience thinking: integrating resilience, adaptability and transformability.** *Ecol Soc* 2010, **15**:1-9.