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How Can Urban Governance Better Respond to Climate Risks in the Global South?

A Multi-Disciplinary Review

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UNU CRIS

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Abstract

This article presents a comprehensive review of urban climate risks in the Global South across four themes: vulnerability, risk research, responses, and governance. Experts from nine research fields have contributed reviews summarising the current state of knowledge in their respective fields. Their analyses highlight the challenges in responding to urban climate risks in the Global South, as well as the gaps in current urban governance frameworks that need to be addressed to effectively manage these risks. Drawing on the literature reviewed, the article also presents a citation network analysis to understand the ways in which different fields contribute to integrated solutions for urban governance and climate risk management. The results indicate that while there is some level of knowledge sharing across certain fields of expertise, others remain largely fragmented, and no single discipline can fully address the complexity of urban climate risk. Therefore, effective solutions must be holistic and multidisciplinary, grounded in the lived realities of urban dwellers.

Keywords

climate risks, urban governance, risk perception, risk responses, global South, multi-disciplinary

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The authors declare that there are no conflicts of interest or competing interests that they are aware of.

Contribution statement

The paper was conceptualised, drafted and critically revised by all the authors. Papers for the review were identified by each author for their field of expertise. Themes for analysis were identified by all the authors in discussion. For the network analysis, data was prepared by Kalubowila and the analysis was carried out by de la Vega. The order of the author names was randomised.

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1. Introduction

The world's human population is now more urban than rural, with urban dwellers facing increasing climate risks (UNHABITAT 2022). Extreme weather and slow-onset events have negatively affected infrastructure, including transportation, water, sanitation, and energy systems, resulting in economic losses, service disruptions, and negative impacts on wellbeing (IPCC 2022). Particularly in the Global South, devastating impacts can be seen as climate risks are unevenly distributed, as are the resources to adapt and react.

The projected increase in urbanisation will add 2.5 billion more inhabitants to cities by 2050 (IPCC 2022) with 90% of those people inhabiting cities in Asia and Africa (UNDESA 2018). Urban environments in the Global South face a triple jeopardy due to increasing frequency and intensity of weather-related hazards, population growth resulting in high levels of exposure, and vulnerability due to their development status (Hugo 2011). In Africa, for example, high population growth and urbanisation in low-elevation coastal zones will be major drivers of exposure to sea-level rise over the next 50 years (IPCC 2022). In East Asia, high-risk settlements have expanded 60% faster than safe ones (Maruyama Rentschler et al. 2022).

Both scientists (Parry 2007) and governments (DEFR$ 2012) have defined and assessed climate risks which are actively being discussed on various platforms. Climate risk can arise and intensify from both (potential) climate change impacts and from human responses to climate change (Reisinger et al. 2020). The impacts are further exacerbated due to underlying conditions such as poverty, conflicts, weak institutional structures, limited human, institutional, and financial capacity, and reliance on climate-sensitive socio-economic activities (UNHABITAT 2022).

Urban governance plays a significant role in either exacerbating (through bad practices) or minimising (through effective planning) exposure of urban dwellers to climate risks. Cities have become a battleground for climate change action. Indeed, the Paris Agreement identifies cities as "important stakeholders, capable of mobilising strong and ambitious climate action" and the United Nations Sustainable Development Goal (SDG) 11 calls for "inclusive, safe, resilient, and sustainable cities" (United Nations n.d.). Hence, the ability of cities to respond to environmental crises, and create pathways towards resilience and sustainability, are of particular interest to the post 2015 agenda.

Cities' contributions to climate action are evident in the multitude of city governments involved in national and global discussions of climate change adaptation and mitigation, as well as voluntary commitments, and engagement with the United Nations Framework Convention on Climate Change (UNFCCC). Further, the large number of important policy documents produced by, or for city governments and international agencies in high- and middle-income countries, speak to the priority that is given to this topic (IPCC 2022). Still, however, the main policies and measures that are in place in cities around the world focus on mitigation and less so on adaptation (Bulkeley 2010), leaving critical knowledge gaps in responding to urban risk.

The authors of this paper point to six specific gaps that need to be explored in depth to better understand how urban governance can address climate risks effectively. Firstly, to better understand the ability and willingness to respond effectively, particularly among the most vulnerable groups. Secondly, understanding differing perceptions of risk is critical to design appropriate responses (UNDRR 2022; IPCC 2022). Thirdly, better use of technology and scientific advancement to improve urban governance is yet to be fully explored. Fourthly, greater investigation of ways of tailoring risk financing strategies to meet the needs of city managers and residents. Fifth, understanding the effects of social policy responses in improving wellbeing of urban populations and lastly, understanding how e-governance can be used to better respond to climate risk.

To deal with the multi-faceted, wicked issues of climate risk and urban governance, diverse perspectives are needed (Sebestyén 2021). This has led the authors to a multi-disciplinary approach, using the current paper to set out the ways, and extent to which the knowledge bases of our varied disciplines connect and contribute to integrated solutions. The specific research questions that this paper tackles are:

RQ1: How do our various fields of expertise contribute to understanding the challenges of urban responses to climate risks in the global South?

RQ2: To what extent do the different knowledge bases speak to each other?

The paper is structured as follows: Section 2 describes the materials and methods used to conduct the literature reviews and citation analysis. The literature reviews, grouped by the four themes (1) Vulnerability and climate risk, (2) Researching risk, (3) Responses to risks and (4) Governance are presented in Section 3, while citations across themes and sub-themes are analysed in Section 4. Section 5 discusses findings from both the reviews and analysis. Section 6 concludes.

2. Materials and Methods

The authors have disciplinary backgrounds that include Anthropology, Disaster Studies, Geography, Economics, Education, Urban Planning, E-government, Information Systems, Migration Studies, Smart Cities, Social Studies and Social Work. We consider ourselves a multi-disciplinary group in the sense of Stember (1991). That is, we work together, drawing on our disciplinary knowledge.

To answer the first research question, we made use of our expertise in different fields to conduct targeted scoping reviews of the lenses, theories and current research relevant to the identified knowledge gaps. We drew on reputable, seminal papers published in peer-reviewed journals since 2015, the launch of the Sustainable Development Goals. We selected this year as the moment in time from which integrated climate risk mitigation gained momentum. Some exceptions were allowed where earlier seminal papers needed to be mentioned for context.

The resulting reviews were shared with the group in a series of discussions from the perspective of each discipline and the authors discussed similarities, differences and points of intersection. Through this process, we identified four key themes. The first is a focus on people in cities, their conditions of being and wellbeing, which we identify as (1) Vulnerability and climate risk. The second is a focus on theoretical perspectives on risk as well as the data that could inform these. We identify this theme as (2) Researching risk. The third theme, (3) Responses or risks, collects observations on common types of responses to urban climate risks. The fourth theme identifies (4) Governance as an important element in addressing these complex problems. The reviews were combined and refined in line with these themes and are presented in Section 3 below.

To answer the second research question, we explored the extent to which the literatures we accessed for the first research question overlapped. We gathered 153 papers cited in the scoping reviews that were indexed on the Web of Science and analysed their citation patterns. Papers were categorised by sub-theme, except for Theme 1, which was considered as a single sub-theme due to the dense recurrence of ideas and theories. We then analysed the extent to which the cited papers share references to understand whether the different disciplines share a common knowledge base. The analysis was done using VOSViewer, with details presented in Section 4 below.

3. Thematic Reviews

Theme 1: Vulnerability and Climate Risk

Vulnerability

In climate science, vulnerability is the susceptibility or inability of a system to cope with the negative effects of climate change which usually is a combination of a system's exposure, sensitivity and adaptive capacity. There is a growing body of research highlighting that in cities in the Global South, climate change is disproportionately and adversely affecting the most marginalised individuals, households and communities (Krellenberg et al. 2017; Kim et al. 2018; Michael, Deshpande and Ziervogel 2019; Habeeb and Javaid 2019; Greenberg 2021). Fraser (2017) emphasises the need to step away from the technical and often hazards-centric approaches and unravel the social and structural drivers of urban risk, adding that social inclusion or exclusion influences patterns of exposure and sensitivity. A dual interrelated state might better explain the vulnerabilities, where some groups, such as migrants or displaced people, will have limited resources to respond to urban climate risk and at the same time be more likely to move into high-risk areas of the city (Habeeb and Javaid 2019).

However, vulnerability to climate risk should not only be equated with the socio-economically weak or the poorest (McQuaid et al. 2018). Inattention to other urban characteristics and layers contributes to the lack of durable and lasting solutions. For example, scholars also argue that location (people living in high-risk locations), skills (lack of prior knowledge or training), and access (to life-saving infrastructure and services) are three components that dictate climate change vulnerability (Twinomuhangi et al. 2021). Ayeb-Karlsson (2020) suggests looking at non-economic losses like wellbeing, dignity, belonging, identity, quality of life and social value to better understand vulnerability. Gender also interacts with socio-economic, institutional and situational variables to produce different degrees of vulnerability (Ahmed et al. 2016; Djoudi et al. 2016; Van Aelst and Holvoet 2016). For example, while urban living presents people of all genders with opportunities not necessarily available in rural settings (Eastin 2018), gender inequality continues to be an underlying driver of vulnerability to climate risk (Dodman, Archer and Satterthwaite 2019; Balikoowa et al. 2019; Umar et al. 2022; Ngigi, Mueller and Birner 2017).

However, simply pointing to 'women's vulnerabilities' is insufficient for gender analysis (Rao et al. 2019; Rothe 2017; Rao 2019; Vercillo, Huggins and Cochrane 2021) as vulnerability also coexists with agency (Evertsen and van der Geest 2020). In addition, those with binary approaches to gender analysis might overlook the specific patterns of vulnerability that gender minorities experience (Gaillard, Gorman-Murray and Fordham 2017). Thus, gender analysis in the context of climate risk requires understanding gender as an organising principle and a social construct (Lama, Hamza and Wester 2021) with consequences for impacts and responses to environmental risk (Schofield and Gubbels 2019).

Recognizing that a range of characteristics intersect to shape adaptive capacity and vulnerability (Van Aelst and Holvoet 2016; Ngigi, Mueller and Birner 2017; Nyantakyi-Frimpong 2020), the concept of intersectionality is gaining prominence as a critical conceptual lens to understand how different forms of vulnerability and inequalities overlap (Osborne 2015; Chu and Michael 2019; Vercillo, Huggins and Cochrane 2021; Amorim-Maia et al. 2022). This is also seen in discussions on the politics of vulnerability (Fraser 2017).

Moreover, rather than merely focusing on the who, we should aim to understand the 'why' of climate change vulnerability. The motivation of people (to choose) to be in cities can help to contextualise risk and vulnerability (Hunt, Aktas, Mahalov et al. 2017). For example, migrants and internally displaced people choose to go to cities to escape a crisis because cities have opportunities for jobs, education, and access to services. However, these opportunities may come with constraints which exclude the people seeking them.

Vulnerability thus needs to be examined alongside the complexity of increasing urbanisation and how it is conditioned or compounded by climate risks. It would need understanding of existing assets of the city (physical, social, and mobility of assets), entitlements, and the nature of climate shocks to which urban dwellers are exposed. The wellbeing of people in urban settings depends on their access to and the reliability of urban systems (for food, water, energy, and transport, for example) and their access to social infrastructure such as health services (Codjoe et al. 2020). Unequal access to resources and benefits, unequal distribution of risks, and the lack of climate action on adaptation of vital services pervades urban developments (Greenberg 2021; Hunt et al. 2017; Codjoe et al. 2020).

Power and voice in urban governance

A resilient city needs to be inclusive in its decision-making, using open dialogue, participatory planning, accountability, and collaboration (Hunt et al. 2017; McQuaid et al. 2018). However, just as more nuanced understandings are needed of how risks and vulnerability are unevenly distributed across different groups, further work is also required on who is allowed to participate to design desired changes (Desphande et al. 2019). Urbanisation practices that exclude the perspectives of the vulnerable and marginalised run the risk of being ineffective, jeopardising sustainable urban development and urban resilience.

Those who lack power and voice are less able to shape outcomes, resulting in the perpetuation of existing patterns of poverty. The exclusion of some urban residents from secure and formalised housing, increases their exposure to risk (Greenberg 2021) and the non-recognition of migrants and displaced people (Chu and Michael 2019), are just a few examples of apparent social and urban exclusion which limits participation in the institutional, social and political levels of the urban fabric (Habeeb and Javaid 2019; Cobbinah et al. 2022). In the built environment, women's voice in decision-making about urban planning remains

limited (Araos et al. 2017; Eastin 2018) and private as well as public spaces are too often constructed in ways that increase women's vulnerabilities (Adeel and Yeh 2018; Jabeen 2019; Mejía-Dorantes and Soto Villagrán 2020). Gender norms can inhibit women from accessing information about climate risk and participating in decision-making around adaptation, as seen in slum communities in Accra, Ghana (Owusu, Nursey-Bray and Rudd 2019).

Further, lack of political capital is often passed from one generation to the next (Cobbinah et al. 2022), making vulnerabilities deep-rooted. Urbanisation does not take a static form and the vulnerabilities of inhabitants are created through a web of local, national, regional, and global political-economic relations (Desphande et al. 2019). Such urban inter-generational and structural climate injustices deserve scholarly attention (Chu and Michael. 2019). Global climate reports recognize that addressing root causes of social and economic inequalities which drive exclusion and marginalisation, could contribute to more inclusive urbanisation.

City governance shapes how people access and benefit from resources and assets. Vulnerable groups need to be better incorporated in governance as they have different needs and face different risks (Kim et al. 2018; Habeeb and Javaid 2019; Cobbinah et al. 2022). This inclusion should go beyond the technical (McQuaid et al. 2018; Fraser 2017). Integrating concepts of gender and intersectionality into research, policy and practice on urban climate risk could promote a better and more holistic understanding of vulnerabilities to climate change (Moser 2017; Chu and Cannon 2021; Reckien et al. 2017; Jordan, 2019; Mustafa et al. 2015).

Theme 2: Researching risk

Risk perception and paradigms

Historical urbanisation processes have contributed to risks through conditioning hazards, exposure and vulnerability (de Souza Leão et al. 2021). Living in an urban environment conditions climate change risk awareness (Lee et al. 2015) and architecture and planning can also inform risk perception and response (Shrestha et al. 2018). Framings of risk have moved from a focus on the technical, to the socio-economic and more holistic understandings (Chan et al. 2018), recognising that cultural and psychological aspects must be considered (Oakes 2019), and social and behavioural data is needed (de Koning and Filatova 2020), to fully understand risk and create efficient responses. Still, policies tend to be dominated by the technical paradigm, assuming that citizens will act in a predictable manner when faced with risks. Through this understanding, the solution to climate risk is better risk information (Abdelhafez et al. 2021; Barbier 2015).

Technical understandings are limited (Yore and Walker 2020), or conditioned, by at least three other risk paradigms. Firstly, even if citizens and decision makers receive appropriate information, they may not have the capacity to act (Lacassin and Lavelle 2016). Under this socio-economic paradigm there are no "natural" disasters – hazards become disasters through structural conditions which create vulnerabilities in exposed locations (Wisner 2020), and impacts are determined by household characteristics and demographics (Lim et al. 2016). The socio-economic framing of risk is, like the technical framing, an objective way of understanding risk. It is (in the main) measurable using methods from the natural, or economic sciences, such as mapping of risk areas and the importance of vulnerability (Fussell 2015).

Secondly, under the psychological paradigm, it is recognised that people may have different thresholds of risk and interpret and respond to risk in differentiated ways (Matin et al. 2018) informed by biases or heuristics. For example, in the United States it has been found that Caucasian, young males are less risk-averse than other groups (Macias 2016). In other words, risk is not absolute, but personal and subjective (Scolobig 2015). This is true both for individuals deciding for themselves, and decision-makers who might be deciding for a city.

Thirdly, people´s interpretation and response are conditioned by cultural norms (Solecki et al. 2017) and thus the context in which information is produced and perceived is critical to consider (Bronnimann and Wintzer 2019). Significant differences in political tradition and societal milieu of a region may influence the social perception of flood risk (Raska et al. 2015) while position on the political spectrum can affect adaptation to risks (Botzen et al. 2016). Due to cultural forces and norms, actions

and behaviours which may seem irrational, can appear more rational if the whole picture is considered (Cornia et al. 2016). For example, place attachment can mean that citizens do not want to leave their homes and livelihoods can mean much more than merely a source of income (Oakes 2019).

Just as cities are composed of a range of ethnicities, ages and vulnerabilities, they are also made up of different minds which have varying ways of understanding and responding to risk (Lechowska 2018). It is crucial to avoid assumptions about what communities will want to know about climate risks (Mabon 2020). Effective governance needs to recognise plurality and move beyond simplistic assumptions about the ways in which people understand, interpret and act on risk information (Rufat et al. 2020), or, adaptation outcomes can exclude, or worsen the situation for marginalised groups (IPCC 2022).

Data and information

Disaster management systems have been in use for decades, drawing on data collected from climate records, city records and operational systems, surveys and post-event analyses. Developments in information and communication technologies make it possible to harvest data from new sources such as smart buildings, city air quality sensors, traffic monitors, social media, satellites and unmanned aerial vehicles (Abid et al. 2021; Ragini et al. 2018; Sebestyén 2021; Yu et al. 2018). This data is current and digital, removing delays and errors in capture. Research is concerned with data aggregation, integration, storage and processing of both structured and unstructured data from multiple sources (Shah et al. 2019; Sun et al. 2020), privacy and security of data, protecting computing infrastructure during disasters, standardisation (Shah et al. 2019) and the ethics of using data for advanced analytical techniques, including environmental impacts (Nordgren 2022).

Large data sets enable the use of sophisticated statistical analytics which can enhance understanding of situations (Sebestyén 2021), enable real-time detection and management of fires, cyclones, floods, air and water pollution, earthquakes and tsunamis (Abid et al. 2021, Wang et al 2016) as well as calculate emergency evacuation paths. Cities can use data from geographic information systems (GIS), satellite images, social media, and Internet of Things (IoT) sensors to identify and respond to disasters (Abid et al. 2021; Sebestyén 2021; Sinha et al. 2019, Wang et al. 2016; Yu et al. 2018; Zhou et al. 2021). Measures of disaster resilience in terms of the recovery situation, the number of casualties, public opinion, disaster site situation, rescue situations, emergency resource allocation and help request information are used to optimise algorithm-based responses (Ragini et al. 2018; Sinha et al. 2019; Wang et al. 2016; Yu et al. 2018). Researchers have proposed architectures for emergency management systems (Shah et al. 2019; Sinha et al. 2019) as well as frameworks for communication during disasters (Wang et al. 2016; Zhou et al. 2021), and have analysed the use of technologies across the phases of disaster recovery from preparedness, through response, recovery and long-term mitigation (Sebestyén 2021; Sun et al. 2020; Yu et al. 2018).

Research also examines the behaviour of people in disaster response situations, including technology adoption to support responses (Zaman et al. 2021). Understandings of human behaviour are facilitated by large data sets where patterns of behaviour can be detected. It may be possible to better understand subjective perceptions of risk through data sources such as social media or discussion forums (Wang et al. 2016). Information-seeking behaviour has been studied in disaster situations (Abid et al. 2021; Rahmi et al. 2019). People use a wide range of information sources including television, radio, internet, local authorities, mobile phones, social media, oral sources, and interpersonal contacts (Wang et al. 2016; Zhou et al. 2021) with information seeking behaviours changing over the course of a disaster situation. The sources that people use are greatly influenced by culture and language, putting some people at greater risk of not finding necessary information or of being misinformed since the reliability of sources is highly variable (Rahmi et al. 2019). This body of work may assist in using the cultural and psychological paradigms of risk to understand behaviour.

Theme 3: Responses to risks

Technical responses

Research as far back as 2001 showed the benefits of electronic communication in disaster situations with e-mail, bulletin boards and web pages being used to inform people about the disaster, relief efforts and for people to keep in touch with family and

recovery services (Paul 2001).

More recent research is concerned with how to maintain communications infrastructure in disaster situations, the architecture of resilient networks (Lee et al. 2018), and how to restore partially damaged networks and the design of resilient technologies such as "balloon networks" that provide wireless nodes in the sky (Rengaraju 2021). Researchers analyse the protocols and standards for IoT to support disaster management efforts (Ray et al. 2017). Applications of IoT technologies to disaster situations have been catalogued, including earthquake and tsunami detection devices, rugged, solar-powered IoT sensors that can adapt to different available networks, flood detection devices mounted under bridges or floating, devices to detect and map lightning, early warning sensors for landslides, apps that enable mobile phones to detect seismic activity (Ray et al. 2017) and IoT data for planning relief operations (Ragini et al. 2018; Sinah et al. 2019).

Others have been concerned with developing software systems to manage disaster situations and apps for individuals to use for information (Sinah et al. 2019). While such technology-based responses are popular, their effectiveness is highly variable and the reasons for failure are not well understood. Research efforts need to extend beyond hardware and software to include the capacities of local governments and the extent to which they can draw on networks for support (Lee 2019).

There are applications of data analytics and artificial intelligence to the challenges of climate change (Cowls et al. 2015). Researchers have reviewed the application of digital tools in the areas of insurance, disaster management, risk management and human displacement and concluded that it is technically and politically feasible for digital technologies to be applied in assessing loss and damage in ways that could change climate politics and justice (Bettini et al. 2020). However, these technologies themselves have a high carbon footprint and it will be necessary to balance their use against the damage they cause (Cowls et al. 2015).

Social protection responses

Over the last decades, social protection policies and programmes have gained momentum as effective strategies to reduce poverty and improve livelihoods (Devereux 2016; Tirivayi et al. 2016). Cash transfer programmes, the most common social protection tool in low- and middle-income countries (LMIC), have expanded, not least due to the COVID-19 crisis, with more than 1 billion recipients globally (Banerjee et al. 2017). These programmes provide financial support for vulnerable households and communities, and have amongst others been found to reduce poverty, improve school attendance, and empower women (Bastagli et al. 2019; Ulrichs et al. 2019).

More recently, there is growing recognition of the role of social protection to reduce climate risks and enhance resilience (Reckien 2017; Ulrichs et al. 2019; Tenzing 2020). Several examples from rural areas in LMICs show how regular cash transfers in response to climate shocks protect beneficiaries from slipping into poverty (Agrawal et al. 2020; Asfaw et al. 2017). Moreover, traditional social protection frameworks are supplemented with disaster risk management and climate change adaptation through 'adaptive social protection' (Béné et al. 2018; Schnitzer 2019; Tenzing 2020). Within this framework, climate information is incorporated into the scale-up of social protection schemes (Daron et al. 2021), aiming to alleviate chronic poverty exacerbated by disasters, extreme events or long-term climate change.

However, the socio-economic context in which programs operate can generate important and sometimes undesired side effects (Cunha, De Giorgi and Jayachandran 2019; Dietrich and Schmerzeck 2019; Filmer et al. 2023). While urbanisation and urban poverty is rising, most social assistance programmes are implemented in rural areas, to reduce rural poverty (Cuesta et al. 2021). Conventional social protection targeting mechanisms that work well in rural areas, like geographical targeting or targeting based on (proxy) means-tests, may be less accurate in urban settings where spatial dimensions of poverty are less clear, and employment or housing conditions more vulnerable and volatile. Hence, designing and targeting appropriate urban social assistance responses remains a key challenge (Cuesta et al. 2021). To date, there is little evidence on effective and inclusive social assistance responses to climate vulnerabilities in cities, not least because reaching the urban poor remains challenging where data and information are limited. Exceptions include studies from urban Indonesia, where social assistance fosters ex-ante and ex-post coping strategies to floods (Fitrinitia et al. 2022), or Bangladesh, where asset transfers increase households' adaptive capacity to climate shocks (Hossain et al. 2018).

An alternative or supplement to social assistance policies are microinsurance solutions that have proven to be effective instruments to avoid disruptive coping strategies during and after climate shocks (Janzen and Carter 2019; Dietrich 2017). Yet, despite substantial subsidies, the spread of microinsurance has remained below expectations, partly due to limited demand particularly amongst the most poor and vulnerable populations (Carter, de Janvry, Sadoulet and Sarris 2017; Platteau, De Bock and Gelade 2017). Poor outreach and understanding of who, when, and where citizens' well-being is most severely affected by climate shocks makes targeting scarce public resources complicated, so responding to urbanisation and growing climatic risks will require social policy instruments tailored to the needs of urban populations.

Risk financing responses

With increasing urbanisation and disaster risk, the costs of disasters in infrastructure-rich urban areas are escalating (McPhillips et al. 2018). City managers need coherent and holistic climate and disaster risk finance strategies to develop shock-responsive and resilient urban governance and planning systems, including climate change adaptation and mitigation, disaster risk reduction and management, and adaptive social protection measures.

Available public service funding is inadequate, so city managers must leverage both public and private investments (Taghizadeh-Hesary et al. 2021) and integrate risk financing into urban development plans (Etinay et al. 2018). This requires understanding the trade-offs inherent in market-based investments (Keenan et al. 2019), as well as the limitations of relying on public financing (Simpson et al. 2019). Adaptive social protection can increase the resilience of urban residents, but how best to finance these services is poorly understood (Tenzing 2020; Béné et al. 2018). City capacity to acquire funding is important, yet cities often face hurdles that higher administrative levels do not (van der Heijden 2019). Importantly, small- and medium-sized cities often grow more rapidly than mega-cities yet have proportionately lower budgets for risk management (Birkmann et al. 2016).

The available financing instruments include integrating risk management into planning processes and municipal budgets, sharing costs through taxation and other value capture instruments, contingency and reserve funds, securitization and structured finance, bonds, insurance, traditional development debt and grant finance, climate adaptation, mitigation and disaster risk reduction funds, contingent credit, and public-private partnerships (Ishiwatari and Surjan 2019; Klose et al. 2016; Lak et al. 2020; Linnerooth-Bayer and Hochrainer-Stigler 2015; Panwar and Sen 2020 2019; Panwar et al. 2022; Sovacool et al. 2018; Weber and Musshoff 2021). These instruments should be layered so resources are available when needed (Linnerooth-Bayer and Hochrainer-Stigler 2015) while ensuring that critical infrastructure is financially protected (Simpson et al. 2020; Sun et al. 2016).

So far, research assesses projects financed by climate adaptation funds and city resilience levels (Dianat et al. 2021; Cardoso et al. 2020; Ribeiro and Pena Jardim Gonçalves 2019). Studies focus on isolated city elements, such as ports (Yang et al. 2018) or on specific measures, such as those for ecosystem-based adaptation (van de Ven et al. 2016). Other considerations include adequate risk information, understanding the timeliness of instruments, risk ownership and responsibility, the cost of capital, and disbursal mechanisms including transparency and accountability (World Bank Group 2014). Without adequate investments, the costs of loss and damage will be mostly borne by residents (Wang et al. 2023) so disaster risk finance cannot be disentangled from issues of environmental justice and equity, including gender.

Theme 4: Governance

Integrative governance to address climate risks

A significant factor contributing to vulnerabilities in cities (Cramer et al. 2018) is the lack of collaboration between the numerous stakeholders in adaptation processes. Consequently, studies have posited that the most complementary ways of understanding and managing climate risk require integrative governance perspectives (Klinke and Renn 2012; Gerkensmeier and Ratter 2018). Following these lines, governance in the Global South in progressing from a top-down decision-making process to a more multi-layered, collaborative and integrative governance system (Märker et al. 2018).

Integrative governance theories and practices focus on the relationships between public, private and hybrid policies and rules, as well as actors and sectors implementing climate risk governance (Visseren-Hamakers 2015). Effective integrative governance in climate risk adaptation provides an understanding of the mechanisms through which policies, actors, levels, and sectors can be integrated and may inspire changes in societal debates, institutional settings and participatory approaches in climate risk governance (Ishiwatari 2019; Slavikova 2018).

To achieve this integration, Forino et al. (2015) argue that mechanisms such as multi stakeholder platforms (MSPs) and learning and sharing opportunities, can be used to enhance coordination and collaboration among stakeholders at different levels, with different agendas. Similarly, Nalau et al. (2015) noted that involvement of non-state actors and the creation of mutual partnerships minimise overlap and duplication of projects and programs, and lead to significant successes in implementing integrative climate risk governance.

Nevertheless, integrative climate risk governance is vulnerable to tensions between actors and negative institutional interactions. According to Becker (2018), there are six major factors influencing collaboration among organisations concerned with climate risk governance. These factors include institutional histories, knowledge, practice, priority, scale, and language. Studies such as Moshtari and Gonçalves (2017), O'Donnell et al. (2018) and Lee (2019) attribute low levels of collaboration among stakeholders in disaster governance to factors such as the structure of interorganizational relations, leadership, ineffective communication, fragmented responsibilities, permanent and temporary networks and lack of trust. Furthermore, the design of national governance systems does not always facilitate collaboration among stakeholders (Becker et al. 2013). For instance, the current architecture of Australia's federal system makes it difficult to deal with complex issues like climate change and its risks. Instead, the political system tends to encourage duplication of responsibilities, vagueness and conflict (Howes et al. 2015).

Despite the substantial research conducted on the prospect and challenges of climate risk governance, there is still a relative paucity of comprehensive and practicable literature about how an integrative governance system can effectively address climate risks in the urban environments of the Global South.

E-governance

Information and communication technologies (ICTs) give governments and other stakeholders two new capabilities to benefit social progress and counteract climate change (Tan et al. 2022). These are the abilities (1) to collect and analyse data to better understand urban climate risk and the effectiveness of responses and (2) to communicate and engage with each other in new ways. These capabilities, applied to governance, constitute electronic governance (e-governance). New technologies can further empower stakeholders with information and the means to communicate their interests, increasing awareness and potential for participation and, in some cases, shifting the power dynamics between stakeholders (He et al. 2017). As stakeholders participate to identify and understand problems, develop solutions and monitor their effectiveness, government entities take on new roles and responsibilities, providing resources and coordinating activities (Millard 2018).

Governments use technologies to share information and get feedback from stakeholders (May and Ross 2018) while the private sector, civil society and individuals use technologies to gather and share information and opinions (Sun and Yan 2020). Government websites share information about environmental issues, but can use their authority to promote unsustainable practices (Feldpausch-Parker and Peterson 2015). In turn, individuals have been able to use technology to track changes to government websites that downplay or give misleading information about environmental issues (Nost et al. 2021). An important component of successful e-governance is the level of sophistication of the "information infrastructure", which consists of information systems, information, standards, organisations, people and social structures, as well as the interactions between these (Engvall and Flak 2022).

ICTs introduce new possibilities for individuals to be better informed about governance, to voice their opinions more effectively and, in some cases, to collaborate in the design and delivery of public services. ICTs are used to mobilise around and gain media coverage for community concerns (He et al. 2017). Community environmental initiatives sometimes meet with limited responses from government and establishing meaningful partnerships takes time and political will (Carlson and Cohen 2018; Royo and

Yetano 2015). Governments have to regulate the harmful effects of the internet, and this can obstruct e-participation (He et al. 2017).

Inequity in access to technology limits the scope and fairness of public participation (Åström et al. 2017, He et al. 2017), and social identity plays a role in how people use e-participation tools (Carlson and Cohen 2018; He et al. 2017; May and Ross 2018; Royo and Yetano 2015; Kreiss 2015). Access goes beyond digital devices and networks to include capabilities and social conditions. Although capability and supportive conditions have been a problem in traditional citizen engagement (He et al. 2017), the possibility that digital solutions might further exclude the most vulnerable is a serious concern. In addition, technologies can have undesirable social impacts which necessitate circumspection (Hantrais and Lenihan 2021). While e-government holds promise, there is limited evidence of long-term effectiveness.

4. Network Analysis

This section examines the linkages between the scoping reviews and analyse the extent to which knowledge transfers occur between topics. Data was gathered from the Web of Science for all 155 papers referenced in the scoping reviews and their citation patterns analysed. The objective of this exercise is to understand the extent to which the different fields speak to each other and draw from similar knowledge bases. Initial explorations showed few direct connections between scoping reviews. There are few references in common, with only seven papers appearing in more than one review. The 155 papers cite each other only 120 times, and a network built upon these citations has a relatively small largest connected component[1] of size 16. The analysis thus turned to the extent to which the papers have shared references – their bibliographic couplings.

Figure 1 shows a weighted network of bibliographic coupling of the papers generated by VOSViewer. Each node is a paper, and a link is drawn between each pair that shares at least one bibliographic reference. The strength of each link is calculated by summing the number of references shared by the pair, and pairs with stronger links are placed closer together in the graph. Colours refer to the eight sub-themes of the scoping reviews. A first visual inspection indicates that similarly-coloured nodes tend to be clustered closer together. This suggests that the connections within sub-themes tend to be stronger than the connections between sub-themes, meaning that papers belonging to the same sub-theme draw more strongly from the same literature than papers from different sub-themes.

Since a visual inspection can be misleading, network statistics were calculated for each of the sub-themes. Each node has a total link strength equal to the sum of the strengths of links related to it. We can aggregate this for each sub-theme by adding the total link strength of all nodes belonging to that sub-theme. However, this method brings two issues. First, we are interested in comparing the connectedness of nodes within their sub-themes and across sub-themes. We then, for each node, differentiate links that connect it to a node in the same sub-theme from links that connect it to nodes in other sub-themes. So, for each node, we can calculate a within-theme total link strength and a between-theme total link strength. Again, we can aggregate these to the sub-theme level.

The second issue comes from sub-themes having different numbers of references, meaning we need to consider average values. Furthermore, between-theme connectedness will tend to be higher than within-theme connectedness because there are always more papers in other sub-themes than within each sub-theme. So we use different denominators for averaging the values: for within-theme connectedness, we average by the number of papers within the sub-theme; while for between-theme connectedness, we average by the number of papers in all other sub-themes.

Table 1 presents two statistics for each sub-theme. The “average internal coupling” (AIC) of a sub-theme is the sum of the total link strength of each node in that sub-theme, restricted to links to other nodes in the same sub-theme, divided by the number of papers in that sub-theme. The “average external coupling (AEC) of a sub-theme is the sum of the total link strength of each node

1 A connected component in a network is a subset of nodes in which any two such nodes can be connected by some path of links. So, if A is linked to B, who is linked to C, A-B-C forms a connected component, even if A and C are not directly connected. Thus, the size of the largest connected component gives information on the density of the network.

in that sub-theme, restricted to links to nodes in other sub-themes, divided by the total number of papers in other sub-themes. It is worth mentioning that, for the seven papers referenced in more than one sub-theme, their respective link strengths were added to both such sub-themes, which is why the number of papers add up to 162 instead of 155.

In general, we can see that AIC tends to be considerably larger than AEC, confirming that papers are indeed more connected within their sub-themes than to other sub-themes as observed before. The statistics also show that sub-themes are more dissimilar in their external coupling than in their internal couplings, since there is more variation in AIC than in AEC. Considering each scoping review separately, a few patterns can be observed. A first pattern is one of low connectivity, with dominance of internal coupling. In Figure 1, data and information (red) and e-governance (green) nodes are positioned in the periphery, suggesting that internal connections dominate connections to other scoping reviews. This is indeed confirmed by the network statistics, particularly for data and information, which has the lowest AEC/AIC ratio. The low connectivity is also shared with technical responses (dark blue). This is not easily noticed in Figure 1 because this sub-theme is different in having an external coupling higher than its internal coupling, although this is mostly due to a very low value of AIC.

An additional pattern can be seen for risk financing (light blue) and social protection (orange) which exhibit high connectivity, although still with dominance of internal couplings. In Figure 1, this pattern is expressed by these sub-themes having a group of nodes which are also in the periphery, while another group of nodes are placed towards the centre, and closer to other sub-themes.

We further observe a pattern of very high connectivity with vulnerability (brown), which has the highest AEC. Internal couplings still dominate, but mostly driven by its AIC, which is also the highest and very significantly above others. In Figure 1, nodes belonging to this sub-theme are also placed in a corner, but their high connectivity means that nodes from other sub-themes in the centre of the graph gravitate towards them.

A final pattern can be seen for integrative governance (yellow) and particularly for risk perception (purple). Their couplings are mid-range, but their AEC is somewhat high for their values of AIC, meaning that they are more connected to other sub-themes than expected for their level of connectivity. Accordingly, in Figure 1, their nodes are placed towards the middle of the graph and, particularly for integrative governance, are quite spread through other sub-themes, looking less clustered together than the others.

In summary, our findings show that the connectedness of scoping reviews varies significantly, but also that they are more internally connected than externally. In Table 1, this is shown by the ratio of AEC/AIC being lower than one for all sub-themes except one. For technical responses this ratio was higher than 1 due to a significantly low internal connectedness. Our research is exploratory and differences could be related to authors choice of papers, rather than fields, or to the way the sub-themes were defined. This analysis and our discussions more generally showed that our different disciplines have similar discussions that are often held in parallel but reflected in disjointed literatures that are segmented from each other.

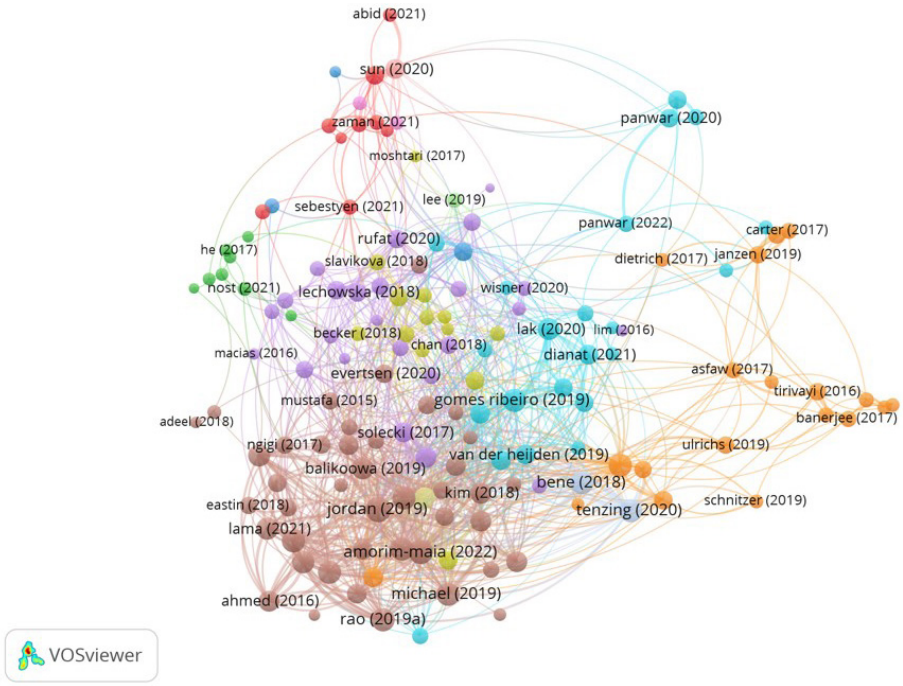

Figure 1. Bibliographic coupling network of papers cited in the review.

Note: Results based on all references cited in the scoping reviews that could be found on the Web of Science. blue=risk financing, orange=social protection, dark blue=technical responses, green=e-governance, brown=vulnerability, purple=risk perception, yellow=integrative governance, red= data and information.

Sub-theme	Colour in Fig. 1	Number of papers	Average Internal Coupling (AIC)	AIC rank	Average External Coupling (AEC)	AEC rank	Ratio AEC/AIC
Data and information	red	12	4.83	4	0.66	6	0.14
E-governance	green	12	1.00	7	0.40	8	0.40
Technical responses	dark blue	7	0.14	8	0.51	7	3.59
Integrative governance	yellow	14	2.14	6	1.11	5	0.52
Risk perception	purple	25	3.44	5	2.34	4	0.68
Risk financing	light blue	25	7.84	3	3.45	2	0.44
Social protection	orange	22	8.50	2	2.78	3	0.33
Vulnerability	brown	43	19.21	1	4.75	1	0.25

Table 1. Network statistics for the sub-themes of the review.

5. Discussion

Mapping the multi-disciplinary landscape of urban climate risk scholarship

Our first research question asks "How do our various disciplinary knowledge-bases contribute to understanding the challenges of urban responses to climate risks in the global South?" Our review reveals that we have at our disposal a rich set of constructs and theories to build on to understand and improve governance through integrative and participatory approaches.

For example, literature from Theme 1: Vulnerability and climate risk, provides an important reminder that to achieve inclusive and integrated urbanisation, poor, marginalised and vulnerable communities, along with their embedded knowledge, should be recognised as partners in policy making and planning towards more sustainable futures. This includes going beyond technical paradigms, to recognise socio-economic factors but also a range of other urban (contextual) characteristics that render people vulnerable. Gender, here, is a useful tool to consider the socially differentiated nature of climate change impacts in the city. However, in order to avoid either oversimplifying or emphasising the importance of gender over other factors, an intersectional approach could be more useful. An intersectional lens on urban policy has synergies with climate justice and recognitional justice, approaches that also surfaced within this theme, and offer a broader and more structural approach to dealing with the root causes, rather than the symptoms of, vulnerability. Based on our review, this includes understanding why people move into high-risk areas in the first place as well as the services and resources offered and distributed by cities. A multi-scale perspective here can help us understand how risk and vulnerability, and the responses of cities are situated within and conditioned by a multi-scale web of relations.

Literature from Theme 2: Researching risk reminds us that the public is a large heterogeneous body and has nuanced views on climate risk. This complexity in risk perception tells us that if assumptions are made about the way in which people perceive and respond to risk, responses to urban climate risks are less likely to succeed. There may not always be an objectively correct response to a risk, but recognising and validating the positions of different members of urban societies will enable more nuanced responses. Synergies with Theme 1 are clear, with the emphasis on not approach climate risk from a solely technological framework but rather to acknowledge the plurality and subjectivity of how risk is understood, interpreted and acted upon. If cities can co-design acceptable solutions with residents, and the message is couched within the psychological and cultural language of their milieu, more effective community-level responses may be possible and vulnerabilities can be addressed rather than exacerbated.

Literature within this theme also suggests that a better understanding of risk perceptions may result from innovative uses of data and information. New insights into human movement, habits, behaviours, or sentiments are available using data from smartphones, sensors, or social media interactions. In addition, satellite and street view imagery for cities makes it possible to link individual outcomes to neighbourhood conditions. Such data may provide ways to confirm and better understand the cultural and psychological paradigms of risk which are fundamental to understanding behaviours.

Literature from Theme 3: Responses to risks, examines specific responses to climate risks including technical solutions to predict and manage disaster situations, social protection programs that provide resources for individuals, and disaster financing mechanisms that cities can access to prepare for and respond to events. These responses could benefit from more nuanced understandings of vulnerability and context to facilitate, for example, the application of technologies or the adaptation of social assistance programs from rural to urban areas. Insights from Themes 1 and 2 could contribute to developing knowledge in this regard and support the tailoring of responses to meet needs more effectively.

Theme 4: Governance, highlights the important role of governance in dealing with climate risks through frameworks for coordination, policy development, resource allocation, transparency, and risk management. Recognising the multitude of perspectives and solutions available, integrative governance becomes essential to ensure the cross-pollination of these through increased collaboration, coordination, and knowledge transfers. The theme also highlights the potential of electronic governance practices and tools to facilitate integrative governance and to support the processes of knowledge-making and sharing. Again, the insights of Themes 1 and 2 would be invaluable to inform the implementation of integrative governance and the design of effective e-government practices and tools.

Mapping disciplinary (dis)connections to climate risk

From reviewing our various themes, it becomes clear that no one approach or discipline is sufficient to address the complexity of urban climate risk and that holistic, multi-disciplinary responses grounded in the lived realities of urban dwellers are essential. Despite a wide set of theories available to apply in developing responses to urban climate risk, numerous gaps exist in the intersection between urban governance, climate risks, and the vulnerable. Our second research question asks "To what extent do the different disciplinary knowledge bases speak to each other?" This review found siloed research which inhibits more integrated, inclusive responses to climate risks in the city and exacerbates knowledge gaps. For example, whilst some sub-themes do already share knowledge (measured by the connectedness of their references), others are largely independent, despite the common overarching topic of climate risks in cities in the Global South. At the same time, we also find that our various disciplines could speak to each other and have, based on our review, significant potential to complement and strengthen each other.

Specifically, our results show that the cited literature on technical responses to climate risks, including the use of technology, risk financing, and social protection, has few connections to other sub-themes. For instance, this literature does not reference risk perception, which is, as discussed, a crucial factor for designing effective responses. The literature on information systems (IS) is similarly disconnected from other sub-themes. Given the potential of IS and the reliance of many solutions on data, analysis and IS, this would appear to be a significant shortcoming in research into climate risk. Is this a lack of awareness of IS? The discipline of IS grew apart from the discipline of computer science in the 1980s, following the realisation that the interaction between computers and society was a separate field of study. Our analysis suggests that the social dimensions of IS is relatively unknown in other fields.

Greater engagement between fields could help develop more effective responses and innovations. Our results represent a first exploratory inquiry into this matter. We believe that consolidating knowledge bases would help to improve our understanding of urban governance responses to climate risks in the Global South.

It is also worth mentioning that an analysis of co-authorship by country of affiliation suggests that authors are largely based in the Global North. (Our data does not allow us to analyse the country of origin of authors.) The top fifteen countries, both in number of papers and in co-authorship connections, are Global North countries, plus India and China. Ghana features in the top fifteen by number of papers but not by co-authorship connections. Greater collaboration should also consider the diversification of the countries that participate in the debate.

Limitations of the study

This study relied on the subject expertise of the authors to identify relevant key texts on the topic. The review was not systematic. We also relied on the author's interpretations of the definitions and boundaries of their fields. This means that the results are indicative only and not conclusive. Our decision to consider only papers published in the Web of Science, while ensuring quality, would also have limited the selection. In particular it would have limited papers originating from the Global South and in the sub-discipline of IS, ICT for development (ICT4D), where many key papers are published in less prominent journals or in conference proceedings. Whether the disciplinary disconnects identified in this study can be generalised to entire disciplines is thus beyond the scope of this paper.

6. Conclusion

Sharing the different disciplinary perspectives on climate change risks and responses to risk in cities, and grouping the results in overarching themes helped us to identify commonalities in research questions but also to acknowledge disciplinary idiosyncrasies. While perspectives and terminologies often differed, this effort showed broad overlap in research interests and the potential of enriching knowledge transfers between disciplines. A significant amount of work is still needed to understand how effective urban governance can reduce exposure to climate risks and improve the adaptive capacity of not just vulnerable groups but all urban dwellers.

In the process, it became clear that climate risk is explored and addressed in diverse ways, ranging from more targeted and technical responses to more critical and structural ones. However, perhaps more importantly, designing effective solutions to mitigate the impacts of climate changes in cities requires a comprehensive and nuanced understanding of the complex systems that connect climate risks, governance, and social welfare outcomes. Encouraging multi-disciplinary research collaborations and establishing sharing points could facilitate the transmission of knowledge between disciplines. Our experience of working together has highlighted the potential and benefit in linking four UNU institutes. This transnational network will, we hope, lead to innovative research, shared learnings and, ultimately, will enhance city-level capacity to respond to urban climate risks.

References

Abdelhafez MA, Ellingwood B, Mahmoud H (2021) Vulnerability of seaports to hurricanes and sea level rise in a changing climate: A case study for Mobile, AL. Coastal Engineering. 167. http://doi.org/10.1016/j.coastaleng.2021.103884.

Abid SK, Sulaiman N, Chan SW, Nazir U, Abid M, Han H, Ariza-Montes A, Vega-Munoz A (2021) Toward an Integrated Disaster Management Approach: How Artificial Intelligence Can Boost Disaster Management. Sustainability 13(22). http://doi.org/10.3390/su132212560.

Adeel M, Yeh AGO (2018) Gendered immobility: influence of social roles and local context on mobility decisions in Pakistan. Transportation Planning and Technology 41(6):660-678. http://doi.org/10.1080/03081060.2018.1488932.

Agrawal A, Kaur N, Shakya C, Norton A (2020) Social assistance programs and climate resilience: reducing vulnerability through cash transfers. Current Opinion In Environmental Sustainability 44:113-123. http://doi.org/10.1016/j.cosust.2020.09.013.

Ahmed A, Lawson ET, Mensah A, Gordon C, Padgham J (2016) Adaptation to climate change or non-climatic stressors in semi-arid regions? Evidence of gender differentiation in three agrarian districts of Ghana. Environmental Development 20:45-58. http://doi.org/10.1016/j.envdev.2016.08.002.

Amorim-Maia AT, Anguelovski I, Chu E, Connolly J (2022) Intersectional climate justice: A conceptual pathway for bridging adaptation planning, transformative action, and social equity. Urban Climate 41. http://doi.org/10.1016/j.uclim.2021.101053.

Araos M, Ford J, Berrang-Ford L, Biesbroek R, Moser S (2017) Climate change adaptation planning for Global South megacities: the case of Dhaka. Journal Of Environmental Policy & Planning 19(6):682-696. http://doi.org/10.1080/1523908X.2016.1264873.

Asfaw S, Carraro A, Davis B, Handa S, Seidenfeld D (2017) Cash transfer programmes, weather shocks and household welfare: evidence from a randomised experiment in Zambia. Journal Of Development Effectiveness 9(4):419-442. http://doi.org/10.1080/19439342.2017.1377751.

Åström J, Jonsson ME, Karlsson M (2017) Democratic innovations: Reinforcing or changing perceptions of trust? International Journal of Public Administration 40(7):575-587. http://doi.org/10.1080/01900692.2016.1162801.

Ayeb-Karlsson S (2021) 'When we were children we had dreams, then we came to Dhaka to survive': urban stories connecting loss of wellbeing, displacement and (im) mobility. Climate And Development 13(4):348-359. http://doi.org/10.1080/17565529.2020.1777078.

Balikoowa K, Nabanoga G, Tumusiime DM, Mbogga MS (2019) Gender differentiated vulnerability to climate change in Eastern Uganda. Climate And Development 11(10):839-849. http://doi.org/10.1080/17565529.2019.1580555.

Banerjee AV, Hanna R, Kreindler GE, Olken BA (2017) Debunking the Stereotype of the Lazy Welfare Recipient: Evidence from Cash Transfer Programs. World Bank Research Observer 32(2):155-184. http://doi.org/10.1093/wbro/lkx002.

Barbier EB (2015) Hurricane Katrina's lessons for the world. Nature 524(7565):285-287. http://doi.org/10.1038/524285a.

Bastagli F, Hagen-Zanker J, Harman L, Barca V, Sturge G, Schmidt T (2019) The Impact of Cash Transfers: A Review of the Evidence from Low- and Middle-income Countries. Journal Of Social Policy 48(3):569-594. http://doi.org/10.1017/S0047279418000715.

Becker P (2018) Dependence, trust, and influence of external actors on municipal urban flood risk mitigation: The case of Lomma Municipality, Sweden. International Journal of Disaster Risk Reduction 31:1004-1012. http://doi.org/10.1016/j.ijdrr.2018.09.005.

Becker P, Abrahamsson M, Hagelsteen M (2013) Parallel structures for disaster risk reduction and climate change adaptation in Southern Africa. Jàmbá: Journal of Disaster Risk Studies 5(2):1-5. http://dx.doi.org/10.4102/jamba.v5i2.68.

Bene C, Cornelius A, Howland F (2018) Bridging Humanitarian Responses and Long-Term Development through Transformative Changes: Some Initial Reflections from the World Bank's Adaptive Social Protection Program in the Sahel. Sustainability 10(6). http://doi.org/10.3390/su10061697.

Bettini G, Gioli G, Felli R (2020) Clouded skies: How digital technologies could reshape “Loss and Damage” from climate change. Wiley Interdisciplinary Reviews-Climate Change 11(4). http://doi.org/10.1002/wcc.650.

Birkmann J, Welle T, Solecki W, Lwasa S, Garschagen M (2016) Boost resilience of small and mid-sized cities. Nature 537(7622):605-608. http://doi.org/10.1038/537605a.

Botzen WJW, Michel-Kerjan E, Kunreuther H, de Moel H, Aerts JCJH (2016) Political affiliation affects adaptation to climate risks: Evidence from New York City. Climatic Change 138(1-2):353-360. http://doi.org/10.1007/s10584-016-1735-9.

Botzen W, Duijndam S, van Beukering P (2021) Lessons for climate policy from behavioural biases towards COVID-19 and climate change risks. World Development 137. http://doi.org/10.1016/j.worlddev.2020.105214.

Bronnimann S, Wintzer J (2019) Climate data empathy. Wiley Interdisciplinary Reviews-Climate Change 10(2). http://doi.org/10.1002/wcc.559.

Bulkeley H (2010) Cities and the governing of climate change. Annual review of environment and resources 35:229-253. https://doi.org/10.1146/annurev-environ-072809-101747.

Cardoso MA, Brito RS, Pereira C, Gonzalez A, Stevens J, Telhado MJ (2020) RAF Resilience Assessment Framework-A Tool to Support Cities’ Action Planning. Sustainability 12(6). http://doi.org/10.3390/su12062349.

Carlson T, Cohen A (2018) Linking community-based monitoring to water policy: Perceptions of citizen scientists. Journal Of Environmental Management 219:168-177. http://doi.org/10.1016/j.jenvman.2018.04.077.

Carter M, de Janvry A, Sadoulet E, Sarris A (2017) Index Insurance for Developing Country Agriculture: A Reassessment. Annual Review of Resource Economics 9:421-438. http://doi.org/10.1146/annurev-resource-100516-053352.

Chan FKS, Chuah CJ, Ziegler AD, Dabrowski M, Varis O (2018) Towards resilient flood risk management for Asian coastal cities: Lessons learned from Hong Kong and Singapore. Journal Of Cleaner Production 187:576-589. http://doi.org/10.1016/j.jclepro.2018.03.217.

Chu EK, Cannon CEB (2021) Equity, inclusion, and justice as criteria for decision-making on climate adaptation in cities. Current Opinion in Environmental Sustainability 51:85-94. http://doi.org/10.1016/j.cosust.2021.02.009.

Chu E, Michael K (2019) Recognition in urban climate justice: marginality and exclusion of migrants in Indian cities. Environment And Urbanization 31(1):139-156. http://doi.org/10.1177/0956247818814449.

Cobbinah PB, Asibey MO, Boakye AA, Addaney M (2022) The myth of urban poor climate adaptation idiosyncrasy. Environmental Science & Policy 128:336-346. http://doi.org/10.1016/j.envsci.2021.12.008.

Codjoe SNA, Gough KV, Wilby RL, Kasei R, Yankson PWK, Amankwaa EF, Abarike MA, Atiglo DY, Kayaga S, Mensah P, Nabilse CK, Griffiths PL (2020) Impact of extreme weather conditions on healthcare provision in urban Ghana. Social Science & Medicine 258. http://doi.org/10.1016/j.socscimed.2020.113072.

Cornia A, Dressel K, Pfeil P (2016) Risk cultures and dominant approaches towards disasters in seven European countries. Journal Of Risk Research 19(3):288-304. http://doi.org/10.1080/13669877.2014.961520.

Cowls J, Tsamados A, Taddeo M, Floridi L (2023) The AI gambit: leveraging artificial intelligence to combat climate change-opportunities, challenges, and recommendations. AI & Society 38(1):283-307. http://doi.org/10.1007/s00146-021-01294-x.

Cramer W, Guiot J, Fader M, Garrabou J, Gattuso JP, Iglesias A, Lange MA, Lionello P, Llasat MC, Paz S, Penuelas J, Snoussi M, Toreti A, Tsimplis MN, Xoplaki E (2018) Climate change and interconnected risks to sustainable development in the Mediterranean. Nature Climate Change 8(11):972-980. http://doi.org/10.1038/s41558-018-0299-2.

Cuesta J, Devereux S, Abdulai AG, Gupte J, Ragno LP, Roelen K, Sabates-Wheeler R, Spadafora T (2021) Urban social assistance: Evidence, challenges and the way forward, with application to Ghana. Development Policy Review 39(3):360-380. http://doi.org/10.1111/dpr.12513.

Cunha JM, De Giorgi G, Jayachandran S (2019) The Price Effects of Cash Versus In-Kind Transfers. Review Of Economic Studies 86(1):240-281. http://doi.org/10.1093/restud/rdy018.

Daron J, Allen M, Bailey M, Ciampi L, Cornforth R, Costella C, Fournier N, Graham R, Hall K, Kane C, Lele I, Petty C, Pinder N, Pirret J, Stacey J, Ticehurst H (2021) Integrating seasonal climate forecasts into adaptive social protection in the Sahel. Climate And Development 13(6):543-550. http://doi.org/10.1080/17565529.2020.1825920.

DEFRA (2012) UK Climate Change Risk Assessment: Government Report. Available at https://www.gov.uk/government/publications/uk-climate-change-risk-assessment-government-report.

Deshpande T, Michael K, Bhaskara K (2019) Barriers and enablers of local adaptive measures: a case study of Bengaluru's informal settlement dwellers. Local Environment 24(3):167-179. http://doi.org/10.1080/13549839.2018.1555578.

Devereux S (2016) Social protection for enhanced food security in sub-Saharan Africa. Food Policy 60:52-62. http://doi.org/10.1016/j.foodpol.2015.03.009.

Dianat H, Wilkinson S, Williams P, Khatibi H (2021) Planning the resilient city: Investigations into using "causal loop diagram" in combination with "UNISDR scorecard" for making cities more resilient star. International Journal of Disaster Risk Reduction 65. http://doi.org/10.1016/j.ijdrr.2021.102561.

Dietrich S (2017) Coping with Shocks: Impact of Insurance Payouts on Small-Scale Farmers. Geneva Papers on Risk and Insurance-Issues and Practice 42(2):348-369. http://doi.org/10.1057/s41288-016-0035-y.

Dietrich S, Schmerzeck G (2019) Cash transfers and nutrition: The role of market isolation after weather shocks. Food Policy 87. http://doi.org/10.1016/j.foodpol.2019.101739.

Djoudi H, Locatelli B, Vaast C, Asher K, Brockhaus M, Sijapati BB (2016) Beyond dichotomies: Gender and intersecting inequalities in climate change studies. Ambio 45:S248-S262. http://doi.org/10.1007/s13280-016-0825-2.

Dodman D, Archer D, Satterthwaite D (2019) Editorial: Responding to climate change in contexts of urban poverty and informality. Environment And Urbanization 31(1):3-12. http://doi.org/10.1177/0956247819830004.

Eastin J (2018) Climate change and gender equality in developing states. World Development 107:289-305. http://doi.org/10.1016/j.worlddev.2018.02.021.

Engvall TS, Flak LS (2022) The state of information infrastructure for global climate governance. Transforming Government- People Process and Policy 16(4):436-448. http://doi.org/10.1108/TG-05-2022-0064.

Etinay N, Egbu C, Murray V (2018) Building Urban Resilience for Disaster Risk Management and Disaster Risk Reduction. 7Th International Conference on Building Resilience: Using Scientific Knowledge To Inform Policy And Practice In Disaster Risk Reduction 212:575-582. http://doi.org/10.1016/j.proeng.2018.01.074.

Evertsen KF, van der Geest K (2020) Gender, environment and migration in Bangladesh. Climate And Development 12(1):12-22. http://doi.org/10.1080/17565529.2019.1596059.

Feldpausch-Parker AM, Peterson TR (2015) Communicating the Science behind Carbon Sequestration: A Case Study of US Department of Energy and Regional Partnership Websites. Environmental Communication-A Journal of Nature and Culture 9(3):326-345. http://doi.org/10.1080/17524032.2014.955039.

Filmer D, Friedman J, Kandpal E, Onishi J (2023) Cash Transfers, Food Prices, and Nutrition Impacts on Ineligible Children. Review of Economics and Statistics 105(2):327-343. http://doi.org/10.1162/rest_a_01061.

Fitrinitia IS, Matsuyuki M (2022) Role of social protection in coping strategies for floods in poor households: A case study on the impact of Program Keluarga Harapan on labor households in Indonesia. International Journal of Disaster Risk Reduction 80. http://doi.org/10.1016/j.ijdrr.2022.103239.

Forino G, von Meding J, Brewer GJ (2015) A Conceptual Governance Framework for Climate Change Adaptation and Disaster Risk Reduction Integration. International Journal of Disaster Risk Science 6(4):372-384. http://doi.org/10.1007/s13753-015-0076-z.

Fraser A (2017) The missing politics of urban vulnerability: The state and the co-production of climate risk. Environment and Planning 49(12):2835-2852. http://doi.org/10.1177/0308518X17732341.

Fussell E (2015) The Long-Term Recovery of New Orleans' Population After Hurricane Katrina. American Behavioral Scientist 59(10):1231-1245. http://doi.org/10.1177/0002764215591181.

Gaillard JC, Sanz K, Balgos BC, Dalisay SNM, Gorman-Murray A, Smith F, Toelupe V (2017) Beyond men and women: a critical perspective on gender and disaster. Disasters 41(3):429-447. http://doi.org/10.1111/disa.12209.

Gerkensmeiera B, Ratter BMW (2018) Governing coastal risks as a social process-Facilitating integrative risk management by enhanced multi-stakeholder collaboration. Environmental Science & Policy 80:144-151. http://doi.org/10.1016/j.envsci.2017.11.011.

Greenberg M (2021) Seeking Shelter: How Housing and Urban Exclusion Shape Exurban Disaster. Sociologica - International Journal for Sociological Debate 15(1):67-89. http://doi.org/10.6092/issn.1971-8853/11869.

Habeeb R, Javaid S (2019) Social Inclusion of Marginal in the Great Climate Change Debate: Case of Slums in Dehradun, India. Sage Open 9(1). http://doi.org/10.1177/2158244019835924.

Hantrais L, Lenihan AT (2021) Social dimensions of evidence-based policy in a digital society. Contemporary Social Science 16(2):141-155. http://doi.org/10.1080/21582041.2021.1887508.

He GZ, Boas I, Mol APJ, Lu YL (2017) E-participation for environmental sustainability in transitional urban China. Sustainability Science 12(2):187-202. http://doi.org/10.1007/s11625-016-0403-3.

Hossain MZ, Rahman MAU (2018) Adaptation to climate change as resilience for urban extreme poor: lessons learned from targeted asset transfers programmes in Dhaka city of Bangladesh. Environment Development and Sustainability 20(1):407-432. http://doi.org/10.1007/s10668-016-9888-2.

Howes M, Tangney P, Reis K, Grant-Smith D, Heazle M, Bosomworth K, Burton P (2015) Towards networked governance: improving interagency communication and collaboration for disaster risk management and climate change adaptation in Australia. Journal Of Environmental Planning and Management 58(5):757-776. http://doi.org/10.1080/09640568.2014.891974.

Hugo G (2011) Future demographic change and its interactions with migration and climate change. Global Environmental Change 21:S21-S33. https://doi.org/10.1016/j.gloenvcha.2011.09.008.

Hunt JCR, Aktas YD, Mahalov A, Moustaoui M, Salamanca F, Georgescu M. (2018) Climate change and growing megacities: hazards and vulnerability. Proceedings of The Institution Of Civil Engineers-Engineering Sustainability 171(6):314-326. http://doi.org/10.1680/jensu.16.00068.

IPCC 2022: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H-O Pörtner, DC Roberts, M Tignor, ES Poloczanska, K Mintenbeck, A Alegría, M Craig, S Langsdorf, S Löschke, V Möller, A Okem, B Rama (eds.)]. Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA 3056 pp. http://doi.org/10.1017/9781009325844.

Ishiwatari M (2019) Flood risk governance: Establishing collaborative mechanism for integrated approach. Progress In Disaster Science 2. http://doi.org/10.1016/j.pdisas.2019.100014.

Ishiwatari M, Surjan A (2019) Good enough today is not enough tomorrow: Challenges of increasing investments in disaster risk reduction and climate change adaptation. Progress In Disaster Science 1. http://doi.org/10.1016/j.pdisas.2019.100007.

Jabeen H (2019) Gendered space and climate resilience in informal settlements in Khulna City, Bangladesh. Environment And Urbanization 31(1):115-138. http://doi.org/10.1177/0956247819828274.

Janzen SA, Carter MR (2019) After the Drought: The Impact of Microinsurance on Consumption Smoothing and Asset Protection. American Journal of Agricultural Economics 101(3):651-671. http://doi.org/10.1093/ajae/aay061.

Jordan JC (2019) Deconstructing resilience: why gender and power matter in responding to climate stress in Bangladesh. Climate And Development 11(2):167-179. http://doi.org/10.1080/17565529.2018.1442790.

Keenan JM, Chu E, Peterson J (2019) From funding to financing: perspectives shaping a research agenda for investment in urban climate adaptation. International Journal Of Urban Sustainable Development 11(3):297-308. http://doi.org/10.1080/19463138.2019.1565413.

Kessler MM (1963) Bibliographic coupling between scientific papers. American Documentation 14:10-25. https://doi.org/10.1002/asi.5090140103.

Kim H, Marcouiller DW, Woosnam KM (2018) Rescaling social dynamics in climate change: The implications of cumulative exposure, climate justice, and community resilience. Geoforum 96:129-140. http://doi.org/10.1016/j.geoforum.2018.08.006.

Klinke A, Renn O (2012) Adaptive and integrative governance on risk and uncertainty. Journal Of Risk Research 15(3):273-292. http://doi.org/10.1080/13669877.2011.636838.

Klose M, Maurischat P, Damm B (2016) Landslide impacts in Germany: A historical and socioeconomic perspective. Landslides 13(1):183-199. http://doi.org/10.1007/s10346-015-0643-9.

Kreiss D (2015) The Problem of Citizens: E-Democracy for Actually Existing Democracy. Social Media and Society 1(2). http://doi.org/10.1177/2056305115616151.

Krellenberg K, Welz J, Link F, Barth K (2017) Urban vulnerability and the contribution of socio-environmental fragmentation: Theoretical and methodological pathways. Progress In Human Geography. 41(4):408-431. http://doi.org/10.1177/0309132516645959.

Lacassin R, Lavelle S (2016) The crisis of a paradigm. A methodological interpretation of Tohoku and Fukushima catastrophe. Earth-Science Reviews. 155:49-59. http://doi.org/10.1016/j.earscirev.2016.01.013.

Lak A, Hasankhan F, Garakani SA (2020) Principles in practice: Toward a conceptual framework for resilient urban design. Journal Of Environmental Planning and Management. 63(12):2194-2226. http://doi.org/10.1080/09640568.2020.1714561.

Lama P, Hamza M, Wester M (2021) Gendered dimensions of migration in relation to climate change. Climate And Development. 13(4):326-336. http://doi.org/10.1080/17565529.2020.1772708.

Leao EBD, Andrade JCS, Nascimento LF (2021) Recife: A climate action profile. Cities. 116. http://doi.org/10.1016/j.cities.2021.103270.

Lechowska E (2018) What determines flood risk perception? A review of factors of flood risk perception and relations between its basic elements. Natural Hazards 94(3):1341-1366 http://doi.org/10.1007/s11069-018-3480-z.

Lee DW (2019) Local government's disaster management capacity and disaster resilience. Local Government Studies. 45(6):803-826. http://doi.org/10.1080/03003930.2019.1653284.

Lee H, Hong SG, Lee KB (2018) An Internet of Things System Architecture for Aiding Firefighters in the scene of Disaster. Journal Of Information Processing Systems. 14(5), 1286-1292. http://doi.org/10.3745/JIPS.04.0092.

Lee TM, Markowitz EM, Howe PD, Ko CY, Leiserowitz AA (2015) Predictors of public climate change awareness and risk perception around the world. Nature Climate Change. 5(11):1014-+. http://doi.org/10.1038/NCLIMATE2728.

Lim HR, Lim MBB, Piantanakulchai M (2016) Determinants of household flood evacuation mode choice in a developing country. Natural Hazards. 84(1):507-532. http://doi.org/10.1007/s11069-016-2436-4.

Linnerooth-Bayer J, Hochrainer-Stigler S (2015) Financial instruments for disaster risk management and climate change adaptation. Climatic Change. 133(1):85-100. http://doi.org/10.1007/s10584-013-1035-6.

Mabon L (2020) Making climate information services accessible to communities: What can we learn from environmental risk communication research? Urban Climate. 31. http://doi.org/10.1016/j.uclim.2019.100537.

Macias T (2016) Environmental risk perception among race and ethnic groups in the United States. Ethnicities. 16(1):111-129. http://doi.org/10.1177/1468796815575382.

Marker C, Venghaus S, Hake JF (2018) Integrated governance for the food-energy-water nexus - The scope of action for institutional change. Renewable & Sustainable Energy Reviews 97:290-300. http://doi.org/10.1016/j.rser.2018.08.020.

Maruyama Rentschler JE, Avner P, Marconcini M, Su R, Strano E, Bernard LAK, Riom CAV, Hallegatte S (2022) Rapid Urban Growth in Flood Zones: Global Evidence since 1985 (English). Policy Research working paper no. WPS 10014 Washington, D.C.: World Bank Group. http://documents.worldbank.org/curated/en/099546404212214703/IDU0ef8bc63a022b304b7c08e7c04aac815d4d98

Matin N, Forrester J, Ensor J (2018) What is equitable resilience? World Development. 109:197-205. http://doi.org/10.1016/j.worlddev.2018.04.020.

May A, Ross T (2018) The design of civic technology: factors that influence public participation and impact. Ergonomics. 61(2):214-225. http://doi.org/10.1080/00140139.2017.1349939.

McPhillips LE, Chang H, Chester MV, Depietri Y, Friedman E, Grimm NB, Kominoski JS, McPhearson T, Mendez-Lazaro P, Rosi EJ, Shiva JS (2018) Defining Extreme Events: A Cross-Disciplinary Review. Earths Future. 6(3):441-455. http://doi.org/10.1002/2017EF000686.

McQuaid K, Vanderbeck RM, Valentine G, Liu C, Chen L, Zhang M, Diprose K (2018) Urban climate change, livelihood vulnerability and narratives of generational responsibility in Jinja, Uganda. Africa. 88(1):11-37. http://doi.org/10.1017/S0001972017000547.

Mejia-Dorantes L, Villagran PS (2020) A review on the influence of barriers on gender equality to access the city: A synthesis approach of Mexico City and its Metropolitan Area. Cities. 96. http://doi.org/10.1016/j.cities.2019.102439.

Michael K, Deshpande T, Ziervogel G (2019) Examining vulnerability in a dynamic urban setting: the case of Bangalore's interstate migrant waste pickers. Climate And Development. 11(8):667-678. http://doi.org/10.1080/17565529.2018.1531745.

Millard J (2018) Open governance systems: Doing more with more. Government Information Quarterly. 35(4):S77-S87. http://doi.org/10.1016/j.giq.2015.08.003.

Moser CON (2017) Gender transformation in a new global urban agenda: challenges for Habitat III and beyond. Environment and Urbanization. 29(1):221-236. http://doi.org/10.1177/0956247816662573.

Moshtari M, Goncalves P (2017) Factors Influencing Interorganizational Collaboration within a Disaster Relief Context. Voluntas. 28(4):1673-1694. http://doi.org/10.1007/s11266-016-9767-3.

Mustafa D, Gioli G, Qazi S, Waraich R, Rehman A, Zahoor R (2015) Gendering flood early warning systems: the case of Pakistan. Environmental Hazards-Human And Policy Dimensions 14(4):312-328. http://doi.org/10.1080/17477891.2015.1075859.

Nalau J, Handmer J (2015) When is transformation a viable policy alternative? Environmental Science & Policy 54:349-356. http://doi.org/10.1016/j.envsci.2015.07.022.

Ngigi MW, Mueller U, Birner R (2017) Gender Differences in Climate Change Adaptation Strategies and Participation in Group-based Approaches: An Intra-household Analysis From Rural Kenya. Ecological Economics 138:99-108. http://doi.org/10.1016/j.ecolecon.2017.03.019.

Nordgren A (2023) Artificial intelligence and climate change: ethical issues. Journal Of Information Communication & Ethics in Society 21(1):1-15. http://doi.org/10.1108/JICES-11-2021-0106.

Nost E, Gehrke G, Poudrier G, Lemelin A, Beck M, Wylie S (2021) Visualizing changes to US federal environmental agency websites, 2016-2020. Plos One 16(2). http://doi.org/10.1371/journal.pone.0246450.

Nyantakyi-Frimpong H (2020) Unmasking difference: intersectionality and smallholder farmers' vulnerability to climate extremes in Northern Ghana. Gender Place And Culture. 27(11):1536-1554. http://doi.org/10.1080/0966369X.2019.1693344.

O'Donnell EC, Lamond JE, Thorne CR (2018) Learning and Action Alliance framework to facilitate stakeholder collaboration and social learning in urban flood risk management. Environmental Science and Policy 80:1-8. http://doi.org/10.1016/j.envsci.2017.10.013.

Oakes R (2019) Culture, climate change and mobility decisions in Pacific Small Island Developing States. Population and Environment 40(4):480-503. http://doi.org/10.1007/s11111-019-00321-w.

Osborne N (2015) Intersectionality and kyriarchy: A framework for approaching power and social justice in planning and climate change adaptation. Planning Theory 14(2):130-151. http://doi.org/10.1177/1473095213516443.

Owusu M, Nursey-Bray M, Rudd D (2019) Gendered perception and vulnerability to climate change in urban slum communities in Accra, Ghana. Regional Environmental Change 19(1):13-25. http://doi.org/10.1007/s10113-018-1357-z.

Panwar V, Sen S (2019) Economic Impact of Natural Disasters: An Empirical Re-examination. Margin-Journal of Applied Economic Research 13(1):109-139. http://doi.org/10.1177/0973801018800087.

Panwar V, Sen S (2020) Fiscal Repercussions of Natural Disasters: Stylized Facts and Panel Data Evidences from India. Natural Hazards Review 21(2). http://doi.org/10.1061/(ASCE)NH.1527-6996.0000369.

Panwar V, Sen S, Shaw R (2022) Introducing proactive sovereign disaster risk financing in India: Potentials and challenges. International Journal of Disaster Risk Reduction 70. http://doi.org/10.1016/j.ijdrr.2021.102760.

Parry ML (2007) Climate Change 2007: Impacts, Adaptation and Vulnerability: Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Vol. 4. Cambridge University Press.

Paul MJ (2001) Interactive Disaster Communication on the Internet: A Content Analysis of Sixty-Four Disaster Relief Home Pages. J&MC Quarterly 78(4):739–753. http://doi.org/10.1177/107769900107800408.

Platteau JP, De Bock O, Gelade W (2017) The Demand for Microinsurance: A Literature Review. World Development 94:139-156. http://doi.org/10.1016/j.worlddev.2017.01.010.

Ragini JR, Anand PMR, Bhaskar V (2018) Big data analytics for disaster response and recovery through sentiment analysis. International Journal of Information Management 42:13-24. http://doi.org/10.1016/j.ijinfomgt.2018.05.004.

Rahmi R, Joho H, Shirai T (2019) An analysis of natural disaster-related information-seeking behavior using temporal stages. Journal of The Association for Information Science and Technology 70(7):715-728. http://doi.org/10.1002/asi.24155.

Rao N (2019) From abandonment to autonomy: Gendered strategies for coping with climate change, Isiolo County, Kenya. Geoforum 102:27-37. http://doi.org/10.1016/j.geoforum.2019.03.017.

Rao N, Lawson ET, Raditloaneng WN, Solomon D, Angula MN (2019) Gendered vulnerabilities to climate change: insights from the semi-arid regions of Africa and Asia. Climate And Development 11(1):14-26. http://doi.org/10.1080/17565529.2017.1372266.

Raska P (2015) Flood risk perception in Central-Eastern European members states of the EU: a review. Natural Hazards 79(3):2163-2179. http://doi.org/10.1007/s11069-015-1929-x.

Ray PP, Mukherjee M, Shu L (2017) Internet of Things for Disaster Management: State-of-the-Art and Prospects. IEEE Access 5:18818-18835. http://doi.org/10.1109/ACCESS.2017.2752174.

Reckien D, Creutzig F, Fernandez B, Lwasa S, Tovar-Restrepo M, McEvoy D, Satterthwaite D (2017) Climate change, equity and the Sustainable Development Goals: an urban perspective. Environment And Urbanization 29(1):159-182. http://doi.org/10.1177/0956247816677778.

Reisinger A, Garschagen M, Mach KJ, Pathak M, Poloczanska E, van Aalst M, Ruane AC, Hoden M, Hurlber M, Mintenbeck K, Pedace R, Rojas Corradi M, Viner D, Vera C, Kreibiehl S, O'Neill B, Pörtner H-O, Sillmann J, Jones R, Ranasinghe R (2020) The Concept of Risk in the IPCC Sixth Assessment Report: A Summary of Cross-Working Group Discussions: Guidance for IPCC Authors. Intergovernmental Panel on Climate Change.

Rengaraju P, Sethuramalingam K, Lung CH (2021) Providing Internet Access for Post-Disaster Communications using Balloon Networks. PE-WASUN 2021 - Proceedings of the 18th ACM Symposium on Performance Evaluation of Wireless Ad Hoc, Sensor, and Ubiquitous Networks, 111–117. https://doi.org/10.1145/3479240.3488497

Ribeiro PJG, Goncalves LAPJ (2019) Urban resilience: A conceptual framework. Sustainable Cities and Society 50. http://doi.org/10.1016/j.scs.2019.101625.
Rothe D (2017) Gendering Resilience: Myths and Stereotypes in the Discourse on Climate-induced Migration. Global Policy 8:40-47. http://doi.org/10.1111/1758-5899.12400.

Royo S, Yetano A (2015) Crowdsourcing as a tool for e-participation: two experiences regarding CO2 emissions at municipal level. Electronic Commerce Research 15(3):323-348. http://doi.org/10.1007/s10660-015-9183-6.

Rufat S, Fekete A, Armas I, Hartmann T, Kuhlicke C, Prior T, Thaler T, Wisner B. (2020) Swimming alone? Why linking flood risk perception and behavior requires more than "it's the individual, stupid". Wiley Interdisciplinary Reviews-Water 7(5). http://doi.org/10.1002/wat2.1462.

Schnitzer P (2019) How to Target Households in Adaptive Social Protection Systems? Evidence from Humanitarian and Development Approaches in Niger. Journal Of Development Studies 55:75-90. http://doi.org/10.1080/00220388.2019.1687877.

Schofield D, Gubbels F (2019) Informing notions of climate change adaptation: a case study of everyday gendered realities of climate change adaptation in an informal settlement in Dar es Salaam. Environment And Urbanization 31(1):93-114. http://doi.org/10.1177/0956247819830074.

Scolobig A, Prior T, Schroter D, Jorin J, Patt A (2015) Towards people-centred approaches for effective disaster risk management: Balancing rhetoric with reality. International Journal of Disaster Risk Reduction 12:202-212. http://doi.org/10.1016/j.ijdrr.2015.01.006.

Sebestyen V, Czvetko T, Abonyi J (2021) The Applicability of Big Data in Climate Change Research: The Importance of System of Systems Thinking. Frontiers In Environmental Science 9. http://doi.org/10.3389/fenvs.2021.619092.

Shah SA, Seker DZ, Rathore MM, Hameed S, Ben Yahia S, Draheim D (2019) Towards Disaster Resilient Smart Cities: Can Internet of Things and Big Data Analytics Be the Game Changers? IEEE Access 7:91885-91903. http://doi.org/10.1109/ACCESS.2019.2928233.

Shrestha SR, Sliuzas R, Kuffer M (2018) Open spaces and risk perception in post-earthquake Kathmandu city. Applied Geography 93:81-91. http://doi.org/10.1016/j.apgeog.2018.02.016.

Simpson NP, Shearing CD, Dupont B (2020) 'Partial functional redundancy': An expression of household level resilience in response to climate risk. Climate Risk Management 28. http://doi.org/10.1016/j.crm.2020.100216.

Simpson NP, Simpson KJ, Shearing CD, Cirolia LR (2019) Municipal finance and resilience lessons for urban infrastructure management: a case study from the Cape Town drought. International Journal of Urban Sustainable Development 11(3):257-276. http://doi.org/10.1080/19463138.2019.1642203.

Sinha A, Kumar P, Rana NP, Islam R, Dwivedi YK (2019) Impact of internet of things (IoT) in disaster management: a task-technology fit perspective. Annals of Operations Research 283(1-2):759-794. http://doi.org/10.1007/s10479-017-2658-1.

Slavikova L (2018) Effects of government flood expenditures: the problem of crowding-out. Journal of Flood Risk Management 11(1):95-104. http://doi.org/10.1111/jfr3.12265.

Solecki W, Pelling M, Garschagen M (2017) Transitions between risk management regimes in cities. Ecology and Society 22(2). http://doi.org/10.5751/ES-09102-220238.

Sovacool BK, Tan-Mullins M, Abrahamse W (2018) Bloated bodies and broken bricks: Power, ecology, and inequality in the political economy of natural disaster recovery. World Development 110:243-255. http://doi.org/10.1016/j.worlddev.2018.05.028.

Stember M (1991) Advancing the social sciences through the interdisciplinary enterprise, The Social Science Journal 28(1):1-14. https://doi.org/10.1016/0362-3319(91)90040-B.

Sun QY, Li XY, Yu F (2016) Designing an emergency continuity plan for a megacity government: A conceptual framework for coping with natural catastrophes. International Journal of Critical Infrastructure Protection 13:28-35. http://doi.org/10.1016/j.ijcip.2016.03.001.

Sun WJ, Bocchini P, Davison BD (2020) Applications of artificial intelligence for disaster management. Natural Hazards 103(3):2631-2689. http://doi.org/10.1007/s11069-020-04124-3.

Taghizadeh-Hesary F, Sarker T, Yoshino N, Mortha A, Vo XV (2021) Quality infrastructure and natural disaster resiliency: A panel analysis of Asia and the Pacific. Economic Analysis and Policy 69:394-406. http://doi.org/10.1016/j.eap.2020.12.021.

Tan DJ, Adedoyin FF, Alvarado R, Ramzan M, Kayesh MS, Shah MI (2022) The effects of environmental degradation on agriculture: Evidence from European countries. Gondwana Research 106:92-104. http://doi.org/10.1016/j.gr.2021.12.009.

Tenzing JD (2020) Integrating social protection and climate change adaptation: A review. Wiley Interdisciplinary Reviews-Climate Change 11(2). http://doi.org/10.1002/wcc.626.

Tirivayi N, Knowles M, Davis B (2016) The interaction between social protection and agriculture: A review of evidence. Global Food Security-Agriculture Policy Economics and Environment 10:52-62. http://doi.org/10.1016/j.gfs.2016.08.004.

Twinomuhangi R, Sseviiri H, Mulinde C, Mukwaya PI, Nimusiima A, Kato AM (2021) Perceptions and vulnerability to climate change among the urban poor in Kampala City, Uganda. Regional Environmental Change 21(2). http://doi.org/10.1007/s10113-021-01771-5.

Ulrichs M, Slater R, Costella C (2019) Building resilience to climate risks through social protection: from individualised models to systemic transformation. Disasters 43:S368-S387. http://doi.org/10.1111/disa.12339.

Umar BB, Chisola MN, Membele G, Kafwamba D, Kunda-Wamuwi CF, Mushili BM (2022) In the Intersection of Climate Risk and Social Vulnerabilities: A Case of Poor Urbanites in Lusaka, Zambia. Urban Forum 0. http://doi.org/10.1007/s12132-022-09473-9.

UNDESA (2020) United Nations e-Government Survey 2020: Digital Government in the Decade of Action for Sustainable Development. United Nations. https://www.un.org/development/desa/publications/publication/2020-united-nations-e-government-survey

UNDRR (2022) Global Assessment Report on Disaster Risk Reduction 2022: Our World at Risk: Transforming Governance for a Resilient Future. Geneva.
United Nations (n.d.) SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable. Available at: https://sdgs.un.org/goals/goal11.

UNHABITAT (2022) World Cities Report 2022: Envisaging the Future of our Cities. United Nations Human Settlement Programme. Nairobi.

Van Aelst K, Holvoet N (2016) Intersections of Gender and Marital Status in Accessing Climate Change Adaptation: Evidence from Rural Tanzania. World Development 79:40-50. http://doi.org/10.1016/j.worlddev.2015.11.003.

Vercillo S, Huggins C, Cochrane L (2022) How is gender investigated in African climate change research? A systematic review of the literature. Ambio 51(4):1045-1062. http://doi.org/10.1007/s13280-021-01631-w.

Visseren-Hamakers IJ (2015) Integrative environmental governance: enhancing governance in the era of synergies. Current Opinion in Environmental Sustainability 14:136-143. http://doi.org/10.1016/j.cosust.2015.05.008.

Wang JB, Wu YL, Yen N, Guo S, Cheng ZX (2016) Big Data Analytics for Emergency Communication Networks: A Survey. IEEE Communications Surveys and Tutorials 18(3):1758-1778. http://doi.org/10.1109/COMST.2016.2540004.

Wang C, Cremen G, Gentile R, Galasso C (2023) Design and assessment of pro-poor financial soft policies for expanding cities. International Journal of Disaster Risk Reduction. http://doi.org/10.1016/j.ijdrr.2022.103500.

Weber R, Musshoff O (2021) Risk-contingent credit for sovereign disaster risk finance. International Journal of Disaster Risk Reduction 56. http://doi.org/10.1016/j.ijdrr.2021.102105.

Wisner B (2020) Five Years Beyond Sendai - Can We Get Beyond Frameworks? International Journal of Disaster Risk Science 11(2):239-249. http://doi.org/10.1007/s13753-020-00263-0.

World Bank Group. (2014) Financial Protection against Natural Disasters: An Operational Framework for Disaster Risk Financing and Insurance. https://openknowledge.worldbank.org/bitstream/handle/10986/21725/949880WP0Box380st0Natural0Disasters.pdf?sequence=1&isAllowed=y

Yang ZL, Ng AKY, Lee PTW, Wang TN, Qu ZH, Rodrigues VS, Pettit S, Harris I, Zhang D, Lau YY (2018) Risk and cost evaluation of port adaptation measures to climate change impacts. Transportation Research Part D-Transport and Environment 61:444-458. http://doi.org/10.1016/j.trd.2017.03.004.

Yore R, Walker JF (2021) Early warning systems and evacuation: rare and extreme versus frequent and small-scale tropical cyclones in the Philippines and Dominica. Disasters 45(3):691-716. http://doi.org/10.1111/disa.12434.

Yu MZ, Yang CW, Li Y (2018) Big Data in Natural Disaster Management: A Review. Geosciences. 8(5). http://doi.org/10.3390/geosciences8050165.

Zaman U, Zahid H, Habibullah MS, Din BH (2021) Adoption of Big Data Analytics (BDA) Technologies in Disaster Management: A Decomposed Theory of Planned Behavior (DTPB) Approach. Cogent Business Management 8(1). http://doi.org/10.1080/23311975.2021.1880253.

Zhou L, Huang HQ, Muthu BA, Sivaparthipan CB (2021) Design of Internet of Things and big data analytics-based disaster risk management. Soft Computing 25(18):12415-12427. http://doi.org/10.1007/s00500-021-05953-5.

de Koning K, Filatova T (2020) Repetitive floods intensify out-migration and climate gentrification in coastal cities. Environmental Research Letters 15(3). http://doi.org/10.1088/1748-9326/ab6668.

van de Ven FHM, Snep RPH, Koole S, Brolsma R, van der Brugge R, Spijker J, Vergroesen T (2016) Adaptation Planning Support Toolbox: Measurable performance information based tools for co-creation of resilient, ecosystem-based urban plans with urban designers, decision-makers and stakeholders. Environmental Science and Policy 66:427-436. http://doi.org/10.1016/j.envsci.2016.06.010.

van der Heijden J (2019). Studying urban climate governance: Where to begin, what to look for, and how to make a meaningful contribution to scholarship and practice. Earth System Governance 1. http://doi.org/10.1016/j.esg.2019.100005.

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