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A climate resilience research renewal agenda: learning lessons from the COVID-19 pandemic for urban climate resilience

Mark Pelling ^a, Winston T. L. Chow ^b, Eric Chu ^c, Richard Dawson ^d, David Dodman ^e, Arabella Fraser ^f, Bronwyn Hayward ^g, Luna Khirfan ^h, Timon McPhearson ⁱ, Anjal Prakash ^j and Gina Ziervogel ^k

^aDepartment of Geography, King's College London, London, UK; ^bSchool of Social Sciences, Singapore Management University, Singapore, Singapore; ^cDepartment of Human Ecology, University of California, Davis, CA, USA; ^dSchool of Engineering, Newcastle University, Newcastle upon Tyne, UK; ^eHuman Settlements, International Institute for Environment and Development, London, UK; ^fSchool of Geography, University of Nottingham, Nottingham, UK; ^gDepartment of Political Science and International Relations, University of Canterbury, Christchurch, New Zealand; ^hSchool of Planning, The University of Waterloo, Waterloo, Canada; ⁱTishman Environment and Design Center, The New School, New York City, NY, USA; ^jBharti Institute of Public Policy, Indian School of Business, Hyderabad, India; ^kDepartment of Environmental and Geographical Science, University of Cape Town, Cape Town, South Africa

ABSTRACT

Learning lessons from the COVID-19 pandemic opens an opportunity for enhanced research and action on inclusive urban resilience to climate change. Lessons and their implications are used to describe a climate resilience research renewal agenda. Three key lessons are identified. The first lesson is generic, that climate change risk coexists and interacts with other risks through overlapping social processes, conditions and decision-making contexts. Two further lessons are urban specific: that networks of connectivity bring risk as well as resilience and that overcrowding is a key indicator of the multiple determinants of vulnerability to both COVID-19 and climate change impacts. From these lessons three research priorities arise: dynamic and compounding vulnerability, systemic risk and risk root cause analysis. These connected agendas identify affordable and healthy housing, social cohesion, minority and local leadership and multiscale governance as entry points for targeted research that can break cycles of multiple risk creation and so build back better for climate change as well as COVID-19 in recovery and renewal.

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1. Introduction

What lessons might the COVID-19 pandemic offer for climate resilience? While impacts and responses to the climate change crisis are observable and increasing, limited action on vulnerability reduction, building adaptive capacity and risk management allow risk to accumulate below the surface in everyday behaviour and development processes. COVID-19 impacts have been swift and widespread bringing into view the depth and unevenness of generic social vulnerability and the compounding characteristics of contemporary development models with direct relevance to climate change risk accumulation and its reduction (Bahadur & Dodman, 2020; Manzano & Manning, 2020; Patel et al., 2020). Compounding characteristics are clearest where the impacts and management responses of COVID-19 and climate change coincide and magnify inequality (Phillips et al., 2020), most notably in urban places (Honey-Rosés et al., 2020) through the effects of connectivity and overcrowding. Lessons here emphasize overlooked elements of our understanding of climate change risk and connected development and risk creation processes (Lewis & Kelman, 2012) that point towards a resilience research and action agenda as part of COVID-19 recovery and renewal.

A first lesson is general – but important for urban places – that social vulnerability, capacity and resilience to climate change do not stand alone, these qualities are dynamic and open to influence from additional risks, in this case COVID-19 impacts and responses. Observed interactions include a compounding of risk and loss including embedded inequalities by gender, race and income or livelihood (e.g. McPhearson et al., 2020). For example, when vulnerable elderly populations are simultaneously exposed to COVID-19 and heatwave risk. Globally, in 2020, about 431.7 million vulnerable people were exposed to extreme heat during the COVID-19 pandemic, including about 75.5 million during a July and August 2020 European heatwave with excess mortality of over 9000 people arising from heat exposure (Walton & van Aalst, 2020). Capacities deployed both against COVID-19 and climate change can generate co-benefits, for example in Vancouver, New York and London where open spaces and buildings enabling flexible use in natural hazard reduction or evacuation were converted into COVID-19 emergency field hospitals (Booth et al., 2020). COVID-19 economic recovery and renewal can impact local risk contexts. The trend for national renewal to prioritize physical infrastructure increases demand for resources. In Vietnam, enhanced demand for sand from urban construction has stimulated large-scale sand mining in

the Mekong River compounding existing hazards of riverbank erosion and flooding (Hackney et al., 2020). Norms for crisis management established during the COVID-19 pandemic have constrained climate change activism (Fisher & Nasrin, 2020). The use of surveillance and denying of mass gatherings may have long lasting implications for civil liberty (Honey-Rosés et al., 2020) including climate activism and protest around specific climate change related events.

A second, and specifically urban lesson is the importance of networked connectivity for building and undermining resilience, including through novel, cascading risks. Connectivity contributes to climate resilience through allowing choices to hedge against, avoid and speedily recover from impacts by bringing redundancy, alternative options and providing fast flows of information and goods (Pelling, 2003). Urban networks are seldom comprehensive with places and social groups varying in their range of connectivity and the degree to which this is relied upon for the everyday functioning of social life, economy and wellbeing, some resist connection. For individuals with resources and access to well functioning markets, social and public systems of exchange, interconnectedness brings diversity and choice in the pathways through which needed resources can be accessed before, during and after an event. Lack of connectivity contributes to economic, social and physical separation and fragmentation and is a key indicator of vulnerability to climate change risk (Ge et al., 2019; Kim et al., 2020). But there are thresholds to networked resilience. Crises and disasters are defined by impacts exceeding the ability of existing systems to function. Once connections fail – through the impact of climate extremes or as a result of pandemic impact or management measures – networks can become pathways for impacts to spread, for example along collapsing supply chains, through diminished remittance flows, or across compromised potable water pipelines (Challinor et al., 2018). Collapsing networks, without safeguards (e.g. engineered design to failure, buffering social policy or insurance), become drivers for novel, emergent and dynamic patterns of exposure and vulnerability. Perhaps most important are the equity consequences of a networked society. This takes urban risk management away from a simple association between connectivity and resilience. How systems dynamism interacts with human behaviour, how such relationships might be measured, monitored and modelled in real time and considered in advance of events to both extend connectivity and put appropriate safeguards in place become fundamental questions for urban risk management that includes, but is not uniquely focussed on, climate change.

A third, and also specifically urban lesson, is the importance of overcrowding as a key indicator of the multiple determinants of vulnerability and exposure to hazards including COVID-19 and climate change. Overcrowding describes conditions with insufficient space to maintain psychological and physical health (Stokols, 1972). This is not the same as high density. Density is defined in physical terms and can bring community building, economic, environmental and health benefits (Credit, 2020). The extent to which high-density urban living inhibits wellbeing leading to overcrowding is a product of urban planning and service provision combined with demographic and household structure and human

behaviour (Bamweyana et al., 2020; Hamidi et al., 2020; Peters, 2020) and is often closely associated with informality in low-income cities (Satterthwaite et al., 2020). Those living in overcrowded conditions are also often placed at risk through dangerous or precarious employment. Root causes in economic inequality and failures of urban planning that force low-income groups to live in overcrowded conditions also generate exposure to climate change related hazards – heat-wave risk is associated with limited access to public open space and poorly ventilated dwellings (Campbella et al., 2018), flood-prone dwellings are often located on land abandoned by higher-income groups and lie outside formally planned urban development (Lall & Deichmann, 2012). High density as overcrowding is more prevalent among lower-income households and renters. In the UK 7% of people in the poorest fifth of households live in overcrowded conditions compared with less than 0.5% of those in the richest fifth (JRF, 2020). During the COVID-19 pandemic, correlation between overcrowded living conditions and low-income occupations has produced a wicked mix of risk drivers including overcrowded housing, overcrowded public space and exposure to disease resulting from low-income livelihoods which often require travel and social interaction in low-wage service sector occupations (Credit, 2020). For unplanned, spontaneous and informal settlements, mainly in Low and Middle Income Countries (LMICs), where household and neighbourhood overcrowding coincides with precarious livelihoods and inadequate basic service provision, risk is further elevated (Wilkinson, 2020), though not all informal settlements experience high density. This is well illustrated by the interplay of resilience and risk in overcrowded neighbourhoods where neighbourhood associations (a benefit of high-density living) have been an important source of resilience through providing trusted information, access to food and water for washing during the pandemic, serving populations unable to access government or market provision. Here local organizing has not only met gaps in service provision but opened dialogue to vision and organize for alternative development futures.¹

The lessons of risk dynamism, connectivity, cascades and root causes for multiple determinants of risk speak directly to the research frontier for climate change risk and social vulnerability. The following sections of this paper explore three elements of this frontier that might undergo more rapid advancement following the lessons of the COVID-19 pandemic for climate risk management. These areas are: an emphasis on compound and dynamic vulnerability, a shift from single to multiple risk domain focus and action to address connections between risk root causes and local conditions of endangerment. [Figure 1](#) draws from this discussion to summarize the paper's contribution.

Just as climate mitigation science looks to a new green deal (Rosenbloom & Markard, 2020) or new social contract (Howarth et al., 2020) as part of social and economic renewal following the pandemic, so we propose the elements outlined in [Figure 1](#) as a renewal agenda for urban climate change resilience research and action. The proposed agenda sees a shift from existing climate change risk management research priorities that see risk as contingent upon hazards events and exposure to one where risk (vulnerability, exposure and

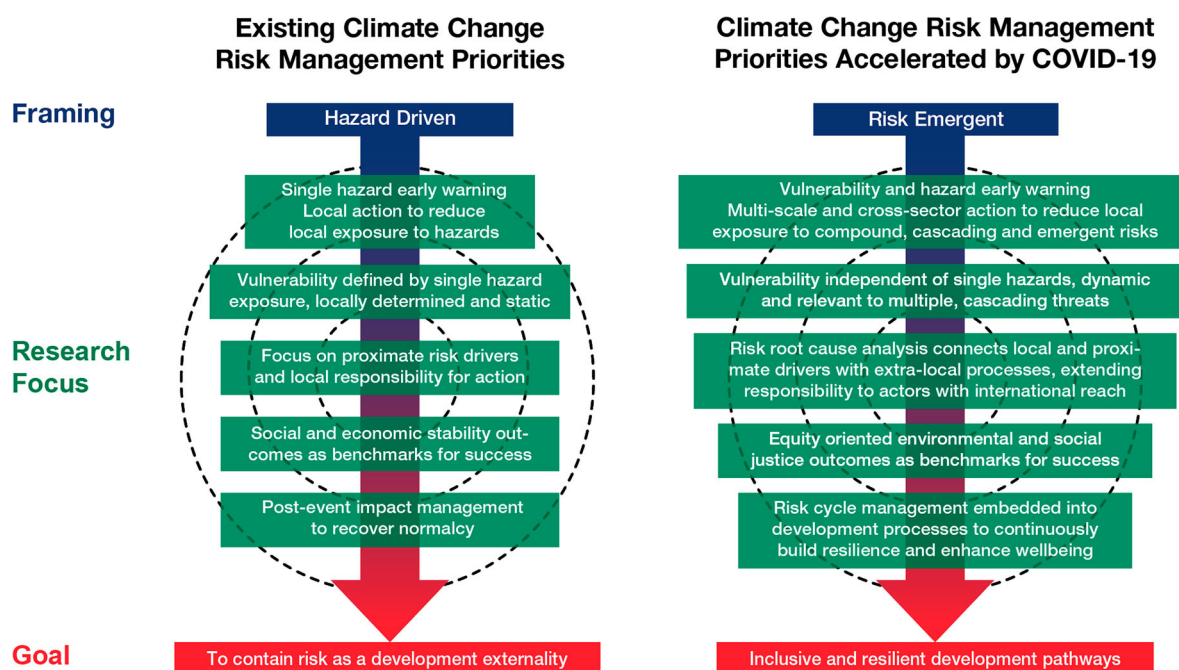


Figure 1. A Climate Resilience Research Renewal Agenda.

hazard) are emergent, vulnerability drivers become as important as hazard drivers and should be mapped and understood even where hazard is not currently indicated to prepare for unanticipated, cascading risks for example through supply chain disruption. The goal of research also shifts emphasis from seeking to understand better how to contain climate change risk as a development externality (often through post-event compensation or response) towards research that can better articulate more inclusive and climate resilient development pathways. Five key research foci are identified as part of the proposed research transition required for these framing and goal shifts which emphasize a more central role for vulnerability and equity considerations, dynamic and cascading understandings of risk and addressing risk causation in development. This agenda describes research that can support the UNDRR (United Nations Office for Disaster Risk Reduction) Sendai Framework for Disaster Risk Reduction 2015–2030 call to build back better from crisis and disaster events.

2. Compound and dynamic vulnerability

The COVID-19 virus arrived in a world already living with climate change (Phillips et al., 2020). The combined impacts of COVID-19 and responses to it are socially and geographically uneven, compounding existing inequalities (UN, 2020). The scale of this challenge is stark. The World Bank (2020a) calculates COVID-19 pushed 50 million additional people into extreme poverty in 2020: sub-Saharan Africa is hardest hit with 23 million people pushed into poverty and a further 16 million in South Asia and 11 million in the rest of the World. The unequal impact of COVID-19 further concentrates on already globally uneven climate risk. The additional weight of poverty as a contribution to climate change risk also has implications for how risk might best be managed. Until now

climate change risk management has primarily targeted hazard reduction (e.g. through watershed management or good quality sanitation) and reducing asset exposure (e.g. through revetment walls or hazard proof housing). Vulnerability reduction, the third component of risk reduction, has been less prominent (Satterthwaite et al., 2020). Social vulnerability reduction lies in enabling social cohesion, health care, education and local economic development. Interventions are less visible to the media and electorate than engineering investments that reduce hazard or exposure. Even when need is recognized, financing for social vulnerability reduction can be difficult because it overlaps with ongoing social development budgets lying outside the mandate of risk reduction or climate adaptation agencies.

The compounding overlap between COVID-19 impacts and climate risk has generated difficult immediate challenges, for example when homeless shelters (Richard et al., 2021), evacuation centres (Shultz et al., 2020) and refugee camps (Kamrujjaman et al., 2021) designed to protect individuals from natural hazards can increase COVID-19 transmissibility. In urban contexts the design limits of critical infrastructure can be doubly important during a compound event, for example, COVID-19 transmission risks can be increased by poor quality sanitation or unreliable water supply (Dawson, 2020), or when pit latrines or combined sewer systems overflow during floods (Han & He, 2021). This overlap threatens wicked feedback between ill health, precarious livelihoods, inadequate living conditions and risk or impacts from climate change related events. More positively, this brings a potential opportunity for targeted investment in housing and basic services to address vulnerability across pandemic, public health, climate change and everyday natural hazard risks.

The compounding of COVID-19 with climate change risk, impacts and responses is dynamic. Each element changes over time so that risk, impacts, responses and their consequences can

be emergent as well as more predictable or planned. For climate change risk assessment and vulnerability reduction, dealing with emergent properties emphasizes the difference between static measurements of vulnerability defined by a specific hazard (i.e. the characteristics of a population exposed to a specific return period flood event) and a more dynamic approach that is interested in how these characteristics change before, during and after an event (Boubacar et al., 2017). Recognizing vulnerability and risk management as dynamic and at times emergent, set within a multi-risk context brings analysis closer to lived experience. This calls for extended analysis of the shifting entitlements within which assemblages of information, organizational capacity and identity shape specific vulnerability reducing actions (Donovan, 2017) that challenge linear models of risk causation and management (Schipper et al., 2020).

Responding to complexity and the need to reduce social vulnerability, social protection measures offer a tool that is flexible enough to respond to multiple, emerging and overlapping pressures and can be targeted as necessary to reduce risk and loss for the most vulnerable. Social protection includes targeted cash payments and is becoming the tool of choice for humanitarians and others alleviating the impacts of rural food insecurity crisis and drought. This is still in its infancy as a tool for urban risk management including for containing the impacts of pandemic. Social protection can be deployed in advance of impacts to reduce vulnerability (e.g. to provide access to clean drinking water); and during a crisis to contain impacts (e.g. by the livelihood impacts of self-isolation or illness). Universal basic income is gaining traction as a mechanism for support during the COVID-19 crisis with longer-term possibilities for helping manage the consequences of precarious employment (Stahl & MacEachen, 2021). To do so requires greater integration between humanitarian and social protection practitioners from government and large-scale NGOs (Majoor & Pelham, 2018).

Strong support for local action is another approach that is proving important in reducing compound and dynamic vulnerability and risk. The results of local integration can be seen in initiatives led by the urban poor to enhance capacities through COVID-19 that are already producing a legacy to reduce vulnerability to future climate-related hazards. A rapid review identified more than 20 examples of local action to provide hand-washing facilities, organize food distribution and information points in the Kibera slum, Nairobi.² The 'Main Bhi Dilli' campaign in Delhi, started as a grassroots campaign in 2018 to address planning for informal livelihoods, climate change and gender has become a critical mechanism working with the government to tackle health and food insecurity during the pandemic.³ For the urban poor with limited access to basic resources and economic assets, social cohesion and support networks are a critical component of survival and development under climate change and COVID-19, pointing to a key area for research and action to combat compound risk.

3. Systemic risk

A systems view sees emergence, non-linearity and multi-dimensionality in the relationships between risk drivers,

impacts, responses and their consequences for future risk and wellbeing (Pescaroli et al., 2018). This raises the possibility that foresightful planning has limits and so extends the responsibility space for risk management and research beyond those with formal risk management mandates. In the context of the COVID-19 pandemic, this means the impacts of COVID-19 and associated responses have already disrupted systems with consequences for climate change risk – and where climate change risk has impacted this will influence vulnerability and capacity to cope with the COVID-19 pandemic (Lambert et al., 2020).

The COVID-19 pandemic has provided climate change risk managers and researchers with a specific lesson in the systemic behaviour of interconnected social care, public health and livelihoods under a sustained crisis and in the movement of risk along connected supply chains (Sarkis et al., 2020). Systemic risk is less thoroughly recorded in analysis of climate change risks and impacts. Studies of drought and food insecurity crisis have shown how risk and loss can travel and accumulate for the poorest: the 2007/8 food crisis in sub-Saharan Africa was triggered by climate-related events and failed wheat harvests in Australia, Russia and the US leading to commodity speculation, global price hikes and food riots in at least 14 African cities (Berazneva & Lee, 2012). Systems effects are also felt as contagion when losses or incapacities spread. Contagion effects have been noted in the empirical literature on climate change, for example where uncertainty in adaptation decision-making moves risk between political, professional and personal realms (Hanna et al., 2020), but these describe largely localized events, an outcome of knowledge and policy gaps more than the intentional shifting of risk across sectors. The pandemic provides climate change risk management with a live experiment to consider how systems-wide impacts might travel, be responded to and how decision-making and underpinning data systems might be prepared for and improved.

Placing more emphasis on systems has distinct consequences for understanding and managing climate change risk in cities. Urban systems include interconnected natural and physical infrastructure networks and social and economic relationships (McPhearson et al., 2016). These systems also extend beyond the city into local, national and global flows of finance, material, ideas and people. When systems are disrupted in one place impacts can be felt elsewhere. Food systems and remittance flows are two key systems through which risk and resilience are transferred between places. Both pathways of contagion have been active during the COVID-19 pandemic and can provide lessons for climate change risk research. The United Nations World Food Programme (WFP) has estimated 265 million people could face acute food insecurity by the end of 2020, up from 135 million people before the COVID-19 crisis (WFP, 2020). The WFP analysis of food security hot spots under COVID-19 includes places affected by extreme weather events and pests, such as the current locust plague impacting food production in 23 countries (World Bank, 2020b). Remittances sent by migrants to home families can normally serve as a buffer against risk (for example from higher food prices), but as richer county economies and urban centres more generally contract

under the impacts of COVID-19, so remittance flows overseas and to rural families have also been reduced. The World Bank (2021) estimates that as the COVID-19 pandemic and economic crisis continues to spread, remittance flows to low and middle-income countries could fall by 7%, to \$508 billion in 2020, followed by a further decline of 7.5%, to \$470 billion in 2021.

4. Risk root causes

First introduced into disasters studies by Blaikie et al. (1994), risk root cause analysis has received limited attention in climate change adaptation research (Thomas et al., 2018). It links local conditions of endangerment through dynamic pressures to framing objects like geopolitics and economic cycles. Risk root cause analysis shares with other theory, the aim of providing an analytical bridge from the global to the local and historical to the contemporary through the interplay of formal and informal institutions, individual decision-making with decision-making culture (Cleaver, 2012; Kelsall, 2018). Analysis of root causes can help identify virtuous cascades of resilience as well as risk. Risk root cause analysis can help guide the appropriate scale and focus for interventions aiming to build generic resilience to multiple risk scenarios (biological, natural hazards, social, technological).

The COVID-19 pandemic has revealed development failures with deep roots in social, economic, political and technology or knowledge systems. These failures also suggest where effort might be placed to reduce generic vulnerability and enhance resilience including to climate change related risks. The economic, social, political and informational are often tightly connected. Lockdowns have had a disproportionate impact on the mental health and physical wellbeing of children, carers - many of whom are women - and some ethnic minorities (Proto & Quintana-Domeque, 2021). The slowness and limited ability of COVID-19 policy responses to recognize and ameliorate psychological impacts and underlying vulnerabilities mirrors weakness in approaching climate change risk and loss where psychological impacts are rarely considered in research or policy (Kim & Bostwick, 2020; Satterthwaite et al., 2007). Politically, weaknesses in early action, managing uncertainty, building trust in state institutions and planning for equitable recovery are also recognized challenges for climate risk management (Amundsen et al., 2010; Helmrich & Chester, 2020). As COVID-19 responses have matured a key component has been the degree to which local capacities have been integrated into national programmes - from neighbours shopping for each other, to a resurgence in community-based action and local pharmacists administering vaccinations. The importance of combining the strengths of local and extra-local capacities to maximize the interplay of local knowledge and initiative with central capacity is recognized by the humanitarian sector responding to urban disaster risk (Collodi et al., 2019). Here, the so-called Localization agenda has championed local responsibility and accountability in disaster response and early recovery to set in train a more sustainable and inclusive medium to long-term recovery (Murphy et al., 2018). COVID-19 has accelerated this trend where there has been a transfer of

implementation responsibility from international to local and national actors. However, the question remains whether ownership, leadership and resources have also been transferred to local and national actors, or if only a delegation of responsibility has occurred (Centre for Humanitarian Leadership, 2020), and how far nationally-led action has incorporated community-led response.

A root cause approach links dynamic vulnerability and systemic risk to underlying forms of power and politics to explain not only what infrastructure, service and governance deficits exist, but how they came to be. This supports both a relational view of dynamic vulnerabilities and a critical view on how decisions about addressing systemic risks are taken, and in whose interests (Fraser et al., 2020). Although methodologically challenging to trace comprehensively, excavating such causal pathways enables analysis of the functioning of complex urban systems, and the context within which risk management systems and actors operate. There is an urgent need to translate the outcomes of such research into the practice of risk assessments, such that causal analysis becomes a routine pillar of loss and damage and risk assessments. This analysis can assist in identifying entry points for working with development as well as risk management actors across relevant scales, and uphold accountability for risks in ways that acknowledge the complexity of relevant decision-making across a range of actors, rather than drawing down blame for local decision-making failures in acting upon complex driving forces (Van Riet, 2021). A priority for climate vulnerability and adaptation research should also be the use of root cause analysis to foreground the wider political-institutional conditions under which positive initiatives to address broader sets of risks and vulnerabilities, led at and across different scales of governance, have become possible in cities (Goodfellow, 2017; Kelsall, 2018). This can also shed light on the potential for greater sustainability (Collodi et al., 2019; Fox Gotham & Greenberg, 2014).

5. Conclusions

A renewal agenda for urban climate change resilience research and action can be a core component of building back better from the COVID-19 pandemic so that no-one is left behind. A key lesson from COVID-19 as a global pandemic is the extent to which orthodox development - applied across the range of national political contexts - has not succeeded in providing the enabling conditions for human flourishing. National analyses repeatedly find women, racial minorities, the homeless and the poor have less access to health care, are often frontline workers, face greater difficulties in safe self-isolation and so have been hardest hit by COVID-19. These social groups are also amongst the most often identified as being vulnerable to climate change. While climate change is as global risk as COVID-19, climate impacts continue to be constructed and acted upon as local concerns requiring at best national action. This has had the effect of deflecting analysis, policy innovation and the burden of change from the global to the local.

Dynamic vulnerability, systemic risk and risk root causes research are proposed as reinforcing themes in a renewal

research agenda. Together they highlight climate change risk as a coevolving component of development. This common orientation supports calls for climate adaptation research that recognizes social, economic and cultural context and processes on equal terms with the physical dynamics of climate systems and local hazard in shaping risk and pointing towards climate resilient development pathways. Modelling and reducing risk for the future becomes as much about understanding processes driving vulnerability and how these are shaped by multi-scalar processes of politics, markets and social action as it is about understanding climate change projections and scenarios. This opens scope for reducing risk to climate change through strategic interventions in social policy as well as more local contemporary actions on vulnerability and asks questions about the balance between economic growth and vulnerability reduction, who decides and the role of science in providing an evidence base for transparent decision-making.

COVID-19 also changes the context for research on climate change in cities – which must now take place within an existent crisis. Consequent research priorities for risk management include longitudinal studies and monitoring of dynamic vulnerability. A stronger focus on the connection points between systems that spread risk and allow it to move from one sector to another must reach beyond cities to better understand the arrival of risk in and passage of risk through urban contexts. This could include research on remittance flows, commodity supply chains, human mobility and health and social insurance.

The impacts of the COVID-19 pandemic create a natural experiment on the extent to which diverse national and local governance systems have supported personal and economic security. Impacts have been unequal, required a tightening of civil liberties to achieve and concentrated losses amongst the already marginal. Women, racial minorities, the homeless and the economically poor have been shown to have less access to health care, to be overrepresented amongst frontline or precarious workers, face greater difficulties in safe self-isolation and so have been hardest hit by COVID-19. These social groups are also amongst the most often identified as being vulnerable to climate change. This highlights the existence of common vulnerability drivers across different contexts – and the opportunity to build resilience to multiple risks, adding value to investments. Areas for focus include affordable and healthy housing and basic services, community cohesion, minority and local leadership and partnership with local government set in the context of national and global risk drivers and opportunities for intervention. Perhaps the overarching lesson of the COVID-19 pandemic for climate change adaptation research is to encourage movement from seeing vulnerability and adaptation through a lens of local development – leading to localized and fragmented action – to seeing vulnerability, impacts and adaptation as outcomes of multi-scalar development pathways expressing locally but with national and global roots requiring local, national and global research and action.

Notes

1. For examples of organized urban poor action on COVID-19 opening transformative possibilities for development and climate risk reduction see: [https://saludconlupa.com/noticias/las-torres-de-](https://saludconlupa.com/noticias/las-torres-de)

[chile-donde-no-rige-la-cuarentena/](https://www.iiied.org/beyond-covid-19-grassroots-visions-change)

2. <https://www.kcl.ac.uk/how-do-you-manage-covid-19-with-a-population-density-of-130000-people-per-square-kilometre>
3. <https://www.dawn.com/news/1565366>

Disclosure statement

No potential conflict of interest was reported by the author(s).

Notes on contributors

Mark Pelling is Professor of Geography, King's College London, UK, a specialist on urban institutions and climate change adaptation. He is a Coordinating Lead Author for the IPCC AR6 Working Group II chapter on Cities, Settlements and Key Infrastructure.

Winston T. L. Chow is Associate Professor of Science, Technology and Society; Basket Coordinator for Technology and Society, Singapore Management University. He is an expert in urban risks associated with climate change. He is a Lead Author for the IPCC AR6 Working Group II chapter on Cities, Settlements and Key Infrastructure.

Eric Chu is Assistant Professor, Community and Regional Development, Department of Human Ecology, College of Agricultural and Environmental Sciences, University of California, Davis, United States. He is an expert on local governance and global environmental change. He is a Lead Author for the IPCC AR6 Working Group II chapter on Cities, Settlements and Key Infrastructure.

Richard Dawson is Professor of Earth Systems Engineering, Director of Research and Innovation, Newcastle University, UK. He is an interdisciplinary researcher with an engineering background working on questions of urban change. He is a Lead Author for the IPCC AR6 Working Group II chapter on Cities, Settlements and Key Infrastructure.

David Dodman is Director, Human Settlements at the International Institute for Environment and Development, UK. He is an expert on climate change vulnerability and resilience in urban centres and a Coordinating Lead Author for the IPCC AR6 Working Group II chapter on Cities, Settlements and Key Infrastructure.

Arabella Fraser is a Nottingham Research Fellow, School of Geography, University of Nottingham. She is a social and political scientist whose research specialises in the politics of urban resilience in the global South.

Bronwyn Hayward, is a Professor in the Department of Political Science and International Relations and Director of The Sustainable Citizenship and Civic Imagination Research, University of Canterbury group. Her research focuses on the intersection of sustainable development, youth, climate change and citizenship. She is a Coordinating Lead Author for the IPCC AR6 Working Group II chapter on Cities, Settlements and Key Infrastructure.

Luna Khirfan is Associate Professor, School of Planning at the University of Waterloo, Canada. Her research interests include: urban stream daylighting/deculverting, community climate change adaptation, community engagement, participatory planning, and urban governance, knowledge transfer and mobility and historic preservation and cultural resource management. She is a Lead Author for the IPCC AR6 Working Group II chapter on Cities, Settlements and Key Infrastructure.












Timon McPhearson is Associate Professor of Urban Ecology, Director of the Urban Systems Lab, and research faculty at the Tishman Environment and Design Center at The New School, New York, US. He studies the ecology in, of, and for cities to advance resilience, sustainability, and justice. He is a Lead Author for the IPCC AR6 Working Group II chapter on Cities, Settlements and Key Infrastructure.

Anjal Prakash, is Research Director and Adjunct Associate Professor, Bharti Institute of Public Policy, Indian School of Business, Hyderabad, India. He has two decades of experience in working on water and climate issues focusing on policy research, advocacy, capacity building, knowledge management, networking and implementation of large scale and

multi-country climate change and development projects in South Asia. He is a Lead Author for the IPCC AR6 Working Group II chapter on Cities, Settlements and Key Infrastructure.

Gina Ziervogel, is Associate Professor in the Department of Environmental and Geographical Science at the University of Cape Town, South Africa. She has 20 years experience in the field of adaptation and vulnerability to climate change. She is a Lead Author for the IPCC AR6 Working Group II chapter on Cities, Settlements and Key Infrastructure.

ORCID

Mark Pelling  <http://orcid.org/0000-0002-6472-9875>
 Winston T. L. Chow  <http://orcid.org/0000-0003-1819-597X>
 Eric Chu  <http://orcid.org/0000-0002-5648-6615>
 Richard Dawson  <http://orcid.org/0000-0003-3158-5868>
 David Dodman  <http://orcid.org/0000-0002-1304-3283>
 Arabella Fraser  <http://orcid.org/0000-0003-3869-328X>
 Bronwyn Hayward  <http://orcid.org/0000-0002-4699-3752>
 Luna Khirfan  <http://orcid.org/0000-0003-4978-7521>
 Timon McPhearson  <http://orcid.org/0000-0002-9499-0791>
 Anjal Prakash  <http://orcid.org/0000-0002-3749-0854>
 Gina Ziervogel  <http://orcid.org/0000-0003-4219-6809>

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