# Resilience Scan | January-March 2017

*A review of literature, debates and social media on resilience*

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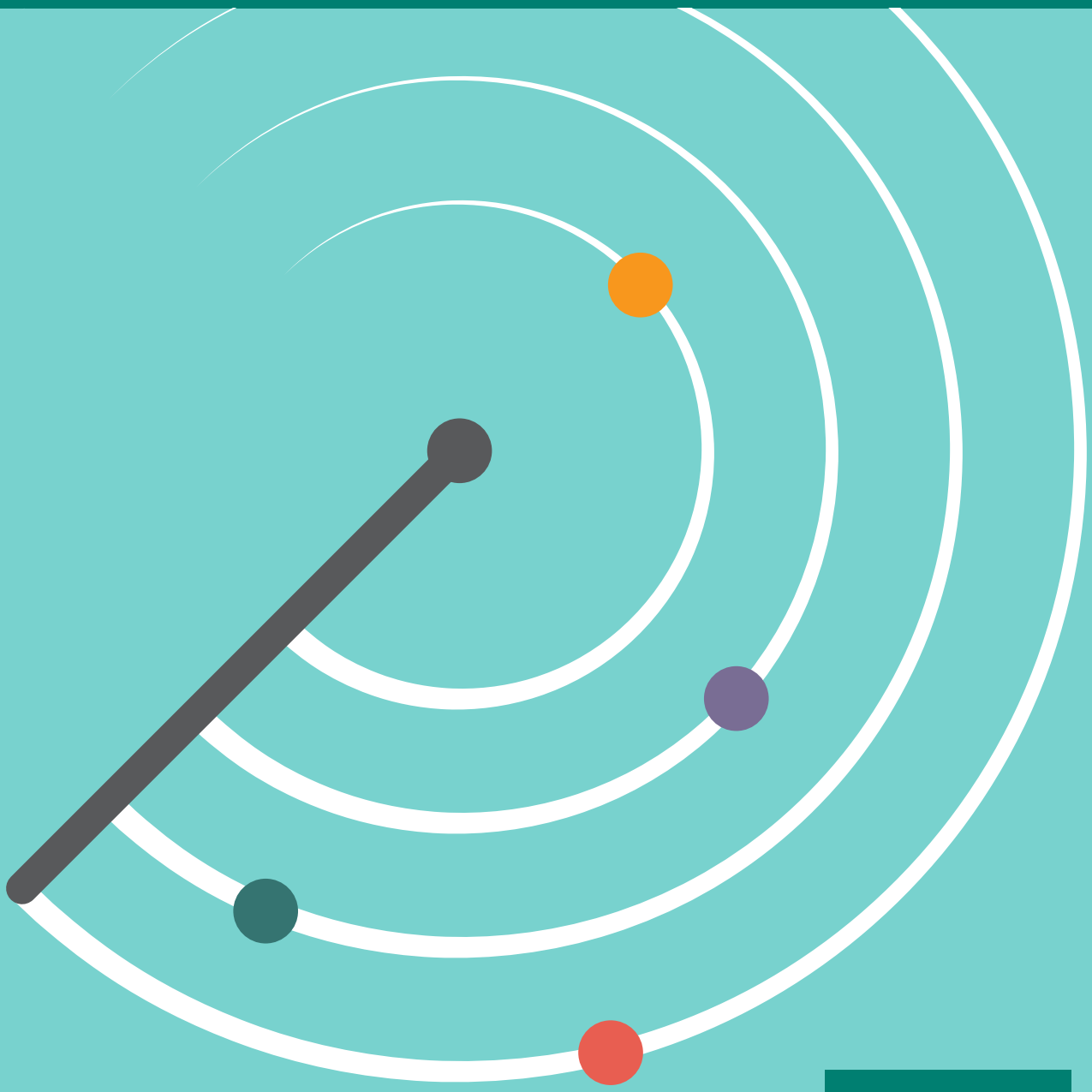

REPORT

As the ‘resilience revolution’ in international development continues, researchers at ODI are capturing the new directions and reviewing the latest thinking in this field through The Rockefeller Foundation-supported Resilience Scan initiative. With a focus on developing countries, we present quarterly analytical reviews of resilience literature, social media activity and key resilience-related events, as well as collating the views of diverse resilience experts. Complementing these wide-ranging quarterly reviews are a number of ‘deep-dive’ analytical papers on key emerging resilience-related topics.

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**Suggested citation:**
Batra, P., Lovell, E., Morsi, H., Schofield, H., Tanner, T., Twigg, J. and Weingärtner, L. (2017) *Resilience Scan January–March 2017: a review of literature, debates and tweets on resilience*. London: Overseas Development Institute.

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This report received support from The Rockefeller Foundation.

# Acknowledgements

This report was written by Pandora Batra, Emma Lovell, Hani Morsi, Holly Schofield, Thomas Tanner, John Twigg and Lena Weingärtner. We gratefully acknowledge the input of Sejal Patel in assisting with the search and methodology. Thanks to Chukwudi Onike and Kevin O'Neil (The Rockefeller Foundation), John Twigg (ODI) and Rebecca Nadin (ODI) for their helpful feedback and support, to John Maher and Anil Shamdasani for copy-editing and proofreading, and to Hannah Caddick for design and communications support.

The authors of the expert view are grateful to Bill Flinn (CARE International UK) and Luisa Miranda Morel (CARE International UK) for their advice, and to Jake Zarins (Habitat for Humanity International) and Amy Kirbyshire (ODI) for reviewing the first draft.

# Acronyms

| | |
|---|---|
| **ACCCRN** | Asian Cities Climate Change Resilience Network |
| **ADB** | Asian Development Bank |
| **API** | application programming interface |
| **BBS** | Build Back Safer |
| **BRACED** | Building Resilience and Adaptation to Climate Extremes and Disasters |
| **CCA** | climate change adaptation |
| **DRM** | disaster risk management |
| **DRR** | disaster risk reduction |
| **FAO** | Food and Agriculture Organization of the United Nations |
| **GNDR** | Global Network of Civil Society Organisations for Disaster Reduction |
| **IAS** | integrated agricultural systems |
| **IDRC** | International Development Research Centre |
| **MEL** | monitoring, evaluation and learning |
| **MENA** | Middle East and North Africa |
| **NGO** | non-governmental organisations |
| **ODI** | Overseas Development Institute |
| **OECD** | Organisation for Economic Co-operation and Development |
| **PPR** | Peste des petits ruminants/sheep and goat plague |
| **PPP** | public–private partnerships |
| **PRIME** | Pastoralist Areas Resilience Improvement through Market Expansion |
| **PRISE** | Pathways to resilience in semi-arid economies |
| **SDG** | Sustainable Development Goal |
| **SIA** | sustainable intensification of agricultural |
| **SLM** | sustainable land management |
| **TARA** | Transformative Adaptation Research Alliance |
| **UCRPF** | Urban Climate Resilience Planning Framework |
| **UNDP** | United Nations Development Programme |
| **WHO** | World Health Organization |

# Contents

# Figures and tables

## Figures



## Tables

# Executive summary

## Self-recovery for resilience

This quarter's expert view section examines post-disaster recovery. Based on recent literature that draws together academic and practice-based knowledge, this expert view offers further insights into self-recovery and its possible implications for the resilience of disaster-affected households and communities.

This section highlights how current knowledge of self-recovery comes mostly from evaluation reports relating to beneficiaries of agency support to self-recovery, rather than the affected population as a whole. The recovery process of those who recover with little or no humanitarian assistance, the 'missing majority', is not well understood (Parrack et al., 2014). It has long been recognised that, rather than remaining passive, disaster-affected groups are the first to respond and to begin recovery from crises. Often, this starts with the construction of a shelter (sometimes temporary, sometimes more permanent), a process that people will begin whether humanitarian assistance reaches them or not.

There is also a call for greater attention to values and perceptions in support for self-recovery. The effects of recent self-recovery assistance on people's knowledge about safer building techniques are unclear. Most case studies and programme reviews outline aspects that are designed to improve safety, but rarely report how many households have successfully incorporated these features. However, even when people do comply with safer construction techniques, the impact on their perceptions of how safe they feel as a result is not uniform. A recent systematic review notes that many interventions claim to support positive assessments of household safety because they increase 'household awareness of the material and construction quality of their homes and the incorporation of safer construction techniques' (Maynard et al., 2017).

The expert view also highlights the importance of considering self-recovery beyond only shelter, despite its central role. From the perspective of disaster-affected individuals and communities, recovery is a long-term process, which by no means ends with the construction of a house, no matter how structurally safe. Self-recovery processes are organic and holistic. Pathways to recovery integrate a range of different components, including basic needs, shelter, livelihoods and health.

A family beside a damaged house near Naglebhare, Nepal, 2015. Photo credit: Asian Development Bank. CC BY-ND 2.0.

## Resilience on Twitter

This Scan provides an analysis of resilience conversations over two quarters, from October 2016 to March 2017, in a range of different contexts, including climate change, agriculture, food security, conflict, urban development, water and economic resilience. For each of these contexts, Table 1 summarises the most prominent discussion themes and key influencers in debates and interactions.

**Table 1. Resilience on Twitter**

| Topic | Key conversations on Twitter | Top influencers on Twitter |
|---|---|---|
| Climate resilience | Technologies for climate-related disaster risk reduction<br>Climate adaptation strategies in different contexts<br>Ways to improve the resilience of the poorest and most vulnerable to climate risk<br>Supporting various indigenous communities to improve their climate resilience | @HelenClarkNZ<br>@UNDPclimate<br>@WHO<br>@UNDP<br>@ACTadaptation@IIED |
| Agriculture resilience | Investing in smallholder farming to boost agriculture resilience<br>Agriculture innovation such as permaculture, automation and mechanisation and the use of solar energy<br>The importance of biodiversity in strengthening agriculture resilience<br>The impact of water shortages on farming<br>The integration of approaches in farming, energy and sustainability to address resilience challenges | @FAOknowledge<br>@ifpri_km<br>@open_resource<br>@agrifoodaid<br>@CIAT_Africa |
| Food security resilience | The importance of food security and nutritional adequacy to promote community well-being<br>The role of innovative agriculture techniques and new scientific approaches in preventing food shortages<br>Climate change disruption of food security resilience<br>The integration of climate, water and agriculture policies<br>Developing resilient food systems in disasters | @CECHR_UoD<br>@FollowAIDF<br>@ACTadaptation<br>@cgiarclimate<br>@WFP |
| Conflict resilience | Ways to enhance the resilience of communities vulnerable to conflict<br>The impact of food and water shortages on conflict resilience<br>Waves of population displacement and migration caused by weakened conflict resilience<br>Strengthening resilience in contexts of protracted and intractable violence | @SarahLouSquires<br>@CRbuildpeace<br>@katiepetersodi<br>@E_lovel<br>@newsecuritybeat<br>@ _PABRA<br>@SaraPantuliano |
| Urban resilience | The impact of climate change on urban resilience<br>The role of design and innovation in building more resilient cities<br>Spatial justice<br>Ways to strengthen urban resilience against disasters and natural hazards<br>Ways to strengthen the resilience of vulnerable urban communities<br>Integration of displaced communities in urban contexts | @ResilienceUrban<br>@100Rescities<br>@RockefellerFdn<br>@urbaninstitute<br>@ICLEI_ResCities |
| Water resilience | Clean water infrastructure in urban and rural contexts<br>Strengthening water resilience of communities in flood- and drought-prone areas<br>Impact of access to water for agriculture on food security<br>Water management strategies intended to improve water resilience | @CCRN_news<br>@2017Water<br>@wwatercouncil<br>@meganrowling<br>@Mitidaption |
| Economic resilience | The role of the private sector in strengthening economic resilience<br>Strategies aimed at bolstering economic resilience in different contexts<br>Ways to improve disaster recovery by focusing on economic resilience strategies<br>Migration, displacement and economic resilience | @worldbank<br>@KathrynTaetzsch<br>@OECDdev<br>@ArreyMcNtui |

## Resilience in the grey literature

Our examination of the grey literature on resilience published between January and March 2017 includes 24 articles from research and private sector institutions, as well as humanitarian and development agencies. These span six broad themes: agriculture and food security, social inclusion and protection, conflict and security, disasters and climate resilience, urban and infrastructure resilience, and measurement and resilience. Compared to the Scan last quarter (Resilience Scan October–December 2016), more material discussing agriculture and food security has been selected and there is less material discussing Agenda 2030.

Grey literature on *agriculture and food security* suggests:

- There is an advantage in using a 'landscape approach' – which recognises the complexity of land management systems and the need to consider human–environment interactions across sectors and scales – to manage and build the resilience of natural resources.
- There is a need for an increase in agricultural productivity, food production and value addition to satisfy the demand for food and decrease dependence on food imports in sub-Saharan Africa.
- It is important to build food security and nutrition resilience through peace-building efforts that aim to protect, save and rebuild lives and agricultural livelihoods impacted by conflict.
- There is a disparity between producers and end markets (both international and national) resulting in producers being subject to inequitable price conditions and high transactional costs.

Grey literature on *social inclusion and social protection* suggests:

- The nature of adaptation to climate change is inextricably linked to the communities that it affects.
- Adaptation actions are most effective and sustainable when they are imbedded in local governance systems that have the capacity and flexibility to identify risks and respond accordingly.
- There is a need to acknowledge the disproportionate impacts of disasters, climate change, conflict and violence for women and girls during humanitarian crises and in emergency relief and recovery efforts.
- Women's capacity as active agents in humanitarian action and resilience building, as well as their 'front line' knowledge of the local environment and local-level risk, is important.

Grey literature on *conflict and security* suggests:

- There is a need for a conflict-sensitive approach to building resilience – that is, an approach which is designed to minimise negative and maximise positive impacts of planned adaptation and resilience interventions in situations of conflict and peace.
- Organisations engaged in the Syrian crisis consider persons with disabilities as homogenous and, therefore, fail to effectively identify those most in need within the population of persons with disabilities.
- Protection assessments fail to consider the resources, skills and assets that people possess, and focus on the negative capacity of persons with disabilities.
- There is a lack of vulnerability- or resilience-based literature that focuses on youth as a specific cohort.

Grey literature on *disasters and climate resilience* suggests:

- Inn fragile and conflict-affected countries, shocks to national economic growth can be absorbed within the first year following a disaster, but lead to negative impacts three years later.
- More in-depth analysis is needed to assess the impact of aid on countries' economic recovery processes following shocks.
- There is a need to increase investments that initiate transformative changes in market, ecological and governance systems.
- Low levels of urban adaptive strategies require local city authorities and non-governmental organisations (NGOs) to work together to provide transparent information and assistance services to households living in flood-prone areas.

Grey literature on *urban and infrastructure resilience* suggests:

- The insurance industry can play a key role in supporting resilience-building approaches by working in partnership with other stakeholders to improve city infrastructure.
- Opportunities for the private sector to invest in urban resilience span water management, big data management, innovative financing and technologies for community engagement.
- It is economically viable to adapt roads in Africa to rising temperatures, as well as to carry out further investigation into adaptation options for roads faced with increasing precipitation and disruption from flooding events.

Grey literature on *measurement and resilience* suggests:

- The three capacities of resilience (absorptive, adaptive and transformative) are all essential for resilience, are interconnected and are mutually reinforcing.
- There is a need to determine the frequency of resilience measurement required to capture the dynamic nature of resilience.
- There is a need to consider international developments when assessing a country's vulnerabilities.
- There is a need for robust methods of quantifying the resilience benefits of natural ecosystem services.

## Resilience in the academic literature

The review in this quarter includes 28 peer-reviewed journal articles on resilience published between January and March 2017. Six dominant themes emerged from the review process.

Academic literature on *agriculture and food security* suggests:

- Bottom-up innovation can help farmers increase their resilience to climate impacts.
- Agroecological resilience is necessary, but not sufficient, for achieving the sustainability of farming systems; social vulnerability and adaptive capacity also need to be addressed to strengthen the disaster resilience of rural societies.
- Resilience building needs to consider contexts, taking specific shocks, livelihoods and adaptation strategies into account.

Academic literature on *conceptual approaches, indicators and measurements* suggests:

- Deepening the integration of climate change adaptation, resilience and sustainability approaches, along with systems thinking, can help decision-makers better prepare for and deal with uncertainty.
- Sharing information and building trust, for instance within public–private partnerships (PPPs), enables greater resilience in supply chain networks.
- Indicators that represent the diversity and connectivity of both technical and social system components are crucial in assessing the resilience of transitioning from a fossil-based to a renewable energy system.

Academic literature on *culture, politics and power* suggests:

- Resilience thinking has facilitated a more nuanced discussion around climate-related migration, but it has not completely replaced the previously dominant storylines that relate migration to conflict.
- Rehabilitation and reconstruction processes can co-produce new urban space and, over time, reshape indigenous forms of architecture.
- Sociopolitical structures and decisions can influence urban built environments and create vulnerabilities. Decision support systems for risk management and urban planning need to recognise these processes to implement resilience policy.

Academic literature on *health* suggests:

- Multi-stakeholder engagement is needed to integrate climate change and resilience indicators with health sector indicators to adequately assess climate resilience.
- The development of new indicators across different areas, including (1) hazard-related impacts, (2) adaptation and resilience, (3) climate change mitigation, (4) economics and finance, and (5) political engagement, can help track progress on health and climate change.

Academic literature on *policy, planning and governance* suggests:

- Urban planners often consider resilience as a cost instead of as an opportunity to tackle uncertainty and facilitate investments in the sector.
- The complexity of the resilience concept continuously presents a challenge for its practical implementation in urban planning. Innovative tools and data sources, including drawing on big data, can help to overcome this barrier.
- Urban resilience thinking and practice need to incorporate political considerations to avoid reinforcing existing challenges around social justice and the social construction of resilience.
- People perceive and address climate change in different ways. Combining climatic data with people's perceptions can therefore enhance the knowledge base on climate-related impacts and support climate-resilient communities.

# 1. Self-recovery for resilience: a multifaceted process

Post-disaster recovery is a critical juncture in building and rebuilding resilience, but it is poorly understood. The old simplistic ('bounce back') notions of recovery as a return to pre-disaster normality are no longer viable, since they imply recreating conditions of vulnerability that lead to disasters. This is why one of the Sendai Framework's four pillars is to 'build back better' in recovery, rehabilitation and reconstruction (UNISDR, 2015). 'Building back better' aligns with the now widely accepted academic understanding of resilience as a transformational capacity or process, in addition to anticipating, resisting and adapting to stresses or destructive forces (Manyena et al., 2011; Pelling and Manuel-Navarrete, 2011; Bahadur et al., 2015).

Shelter plays a key role in wider recovery from sudden-onset events, and hence repair and reconstruction of housing and infrastructure are key elements of humanitarian interventions. However, recovery is a complex and multi-dimensional process, which takes place in greatly altered post-disaster contexts (Tierney and Oliver-Smith, 2012). It is a major operational challenge (within agencies' time, resource and mandate constraints) for actors involved in relief and recovery to provide or support shelter reconstruction that leads to housing and community structures that are safer to live and work in. Providing adequate shelter is 'one of the most intractable problems in international humanitarian response' (Ashdown, 2011). Debates about appropriate approaches to post-disaster shelter – in terms of technologies for building back safer, responding to disaster-affected people's various needs and priorities, and ensuring community participation and empowerment in decision-making – date back to the 1970s (Davis, 1978), but they remain 'live' issues, with continuing criticisms of shelter reconstruction practices that do not improve safety and resilience (Davis and Alexander, 2016; Schilderman and Parker, 2014).

It is within this context that 'self-recovery' in post-disaster shelter responses is receiving increased attention in the humanitarian sector as an important and more cost-effective component in building household resilience after disasters (e.g. Flinn and Echegaray, 2016). Yet despite this increased attention, self-recovery still lacks a clear consensus as to how it should be defined and it is not yet well understood as a process (Schofield and Miranda Morel, 2017). That said, new research is encouraging increased dialogue on the subject. Recent literature reviews provide the groundwork for the advancement of safer self-recovery in both theory and practice. They draw together the academic and practice-based knowledge of support for self-recovery in recent humanitarian interventions to highlight existing gaps or areas for future research, and suggest how this can inform future interventions (Maynard et al., 2017; Parrack et al., forthcoming). Case study and evaluation reports relating to previous assisted self-recovery interventions provide reflections on lessons learned and ways forward from a shelter practice perspective (CARE, 2016). A current multi-disciplinary research project on shelter self-recovery, comprising researchers, humanitarian practitioners, engineers and geoscientists, is engaging with disaster-affected individuals (in Nepal and the Philippines) and national and international experts through interviews, focus groups, field observations, roundtable events, conferences and workshops.[1]

Based on the knowledge and thinking to have emerged from this new research, this expert view offers further insights into self-recovery and what its implications may be for the resilience of disaster-affected households and communities.

1 'Promoting Safer Building Supporting Safer Self-Recovery' (November 2016–July 2017). The partners are the Overseas Development Institute, CARE UK, University College London and the British Geological Survey. The project is funded by the UK Government's Global Challenges Research Fund through the UK Natural Environment Research Council, Ref: NE/P016200/1.

## 1.1. Self-recovery and the 'missing majority'

Current knowledge of self-recovery comes mostly from evaluation reports relating to beneficiaries of agency support to self-recovery, rather than the affected population as a whole (e.g. CARE, 2016; see also Maynard et al., 2017). The recovery process of those who recover with little or no humanitarian assistance is not well understood. These groups remain under-represented because they are often difficult to reach as a result of geographical isolation or do not fall within the beneficiary selection processes of humanitarian organisations (Parrack et al., 2014; Schofield and Miranda Morel, 2017).

This unheard voice consistently constitutes the majority. It is estimated that, over the past decade, humanitarian organisations have seldom met as much as 30% (and often significantly less) of the total shelter needs within the 12 months following an event. For example, in the cases of Cyclone Sidr (Bangladesh 2007) and Cyclone Nargis (Myanmar 2008), only 1% and 2.5%, respectively, of the total shelter need was met (Parrack et al., 2014). The remaining households self-recovered with little or no shelter assistance.

Disasters can cause widespread damage and loss of housing, loss of jobs and livelihoods, disruptions to markets, social networks and place attachments, and increased economic demands, as well as injury and loss of life. However, the indicators of recovery used in humanitarian practice rarely recognise this multi-dimensional reality; approaches tend to be sectoral, dealing with key facets such as shelter, health and livelihoods in isolation, even if the links between them have long been recognised in academic literature (e.g. Bolin and Stanford, 1991). The current framing of the term 'self-recovery' is rooted within the shelter and construction sector, as a process whereby 'disaster-impacted households rebuild or repair damaged or destroyed homes using their own assets through self-building or using the local informal building sector' (Parrack et al., 2014: 47).

It has long been recognised that, rather than remaining passive, disaster-affected groups are the first to respond and start to recover from crises. Often, this starts with the construction of a shelter (sometimes temporary, at other times more permanent, depending on the context), and this is a process which people will begin whether humanitarian assistance reaches them or not. People's tendency to reconstruct pre-disaster vulnerabilities through the use of substandard building materials and building techniques that lead to unsafe structures is a strong argument for the humanitarian shelter sector to provide more support to people in their self-recovery process (CARE, 2016; Parrack et al., 2014). Interventions providing support to self-recovery have been characterised by the provision of material, financial and/or technical assistance. Material

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assistance may include the provision of materials and tools for construction as well as support for salvaging and reusing debris. Financial assistance includes cash or voucher provision. Technical assistance includes the provision of guidance on construction through training and/or guidelines and mass communications (Maynard et al., 2017). However, the use of material, financial and technical inputs of other actors – to whatever degree – invites questions as to whether those who are provided with such assistance can truly be said to be self-recovering.

## 1.2. Values and perceptions in supported self-recovery

The projected impact of supported self-recovery interventions is that people experience 'longer term and/or wider scale physical, social, economic and environmental recovery and resilience' (Maynard et al., 2017: 8) by building stronger and safer houses and – importantly – by acquiring and transmitting learning about safer building techniques (Parrack et al., 2014; CARE, 2016).

Concern that simply providing people with information on safer construction will not necessarily result in more resilient housing forms part of the justification for complementing beneficiary awareness raising with technical training for local carpenters and masons in techniques to 'Build Back Safer' (BBS) (CARE, 2016). However, the effects of recent self-recovery assistance on people's knowledge about safer building techniques has been described as 'unclear' (Maynard et al., 2017: 62). Most case studies and programme reviews outline aspects which are designed to improve safety, but rarely report how many households have successfully incorporated these features (Parrack et al., forthcoming).

Reconciling people's diverse priorities and values with the resilience-building objectives of safer shelter interventions is a significant challenge, particularly given the emphasis on beneficiary choice and agency in self-recovery, as well as on transferring risk management decision-making from humanitarian agencies to homeowners (Parrack et al., 2014: 52). Recent field research in the Philippines found that in a number of communities, despite having received training and information on BBS, and despite often still being able to recite key BBS messages three years after a typhoon, compliance had been relatively low. While many

community members cited lack of finance as a reason for this, others simply suggested that BBS had not been a priority. This contrasted with research in Nepal, where government cash grants for reconstruction were conditional and based upon compliance with safer building techniques. Although the approach adopted in Nepal was not entirely unproblematic – with grants often not sufficient for the conditions to be met – it did mean that those able to top up with grants were often more inclined to incorporate the messages in the reconstructed housing.

Even when people comply with safer construction techniques, the impact on their perceptions of how safe they feel as a result is not uniform. The systematic review by Maynard et al. (2017) of the literature on self-recovery notes that many interventions claim to support positive assessments of household safety because they increase 'household awareness of the material and construction quality of their homes and the incorporation of safer construction techniques'. Additionally, approaches often claim to result in other positive outcomes for the homeowners, such as increased self-reliance, which result from their ownership of the recovery process (Maynard et al., 2017: 62). However, while the recent research in the Philippines and Nepal found evidence to support such claims, it did find substantial evidence to counter them.

People's perception of their recovery was often shaped by their perceived safety and resilience to current and future events. A lack of confidence in abilities to construct in line with BBS messages or governmental standards, or a lack of trust in the materials being used, contributed substantially to people's subjective assessments of their own safety and resilience, and consequently to their perceptions of the extent to which they felt they had recovered. Monitoring of reconstruction by trained engineers is important for ensuring the resilience of post-disaster housing (Parrack et al., forthcoming). Yet in Nepal, despite undergoing training, some people still felt uncertain about what constituted safer building because no supervision from engineers was available. This uncertainty contributed substantially to the homeowners' fear of future earthquakes. Whether these households had managed to construct safer houses remains uncertain, but the experiences show that subjective perceptions of resilience are an important facet of people's recovery process. These are more difficult to measure and quantify than objective determinants of resilience and have received comparatively less attention in the resilience debate to date (Jones and Tanner, 2015).

*People's perception of their recovery was often shaped by their perceived safety and resilience to current and future events*

## 1.3. Self-recovery is not only about shelter

That shelter plays a central role in self-recovery, and has the potential to increase household resilience, is not disputed, and physical reconstruction has been suggested as a 'crude surrogate' for other aspects of economic and societal recovery (Platt et al., 2016: 456). Yet from the perspective of disaster-affected individuals and communities, recovery is a long-term process which by no means ends with the construction of a house, no matter how structurally safe. Self-recovery processes are organic and holistic. Pathways to recovery integrate a range of different components, including basic needs, shelter, livelihoods and health. Each of these elements possesses different and shifting levels of importance, depending on the social, political, economic, environmental and temporal context in which recovery takes place (Schofield and Miranda Morel, 2017). These changing conditions and household needs and priorities are a challenge for attempts to support self-recovery (Maynard et al., 2017).

For example, in both the Philippines and Nepal, people had often already constructed a shelter by the time shelter assistance arrived, and so they often made use of new materials for sheltering their livestock (Schofield and Miranda Morel, 2017). In the Philippines after Typhoon Haiyan (November 2013), following the construction of a shelter, most affected households rapidly focused on recovering their livelihoods, at which point livelihood development took priority over future shelter assistance (see also CARE, 2016). The recent fieldwork also found that households and communities – the majority now with shelters – felt that they would be unable to fully recover until their livelihoods had been re-established. Yet livelihood self-recovery was challenging because of pre-existing indebtedness or the lack of finances required to restock materials and tools. Livelihood recovery interventions in the Philippines following Typhoons Haiyan and Haima (2016) were often viewed favourably by community members because of their resilience-building potential, allowing families to purchase livestock to rear and sell. In a number of communities, families opted to pool the livelihood cash assistance to invest in replacing or repairing more costly farming infrastructure, such as rice mills, which would benefit the recovery and resilience of the entire community, and not just the targeted.

Research repeatedly shows that disaster-affected individuals take steps to recover, establish and/or diversify livelihoods in the aftermath of disaster even where livelihood interventions do not take place. Diversification of livelihood strategies is a common and central coping and recovery mechanism, particularly in the rural context. When disasters destroy agricultural lands, wage-labourers often seek to diversify incomes by moving into non-farming activities (Masud-All-Kamal, 2013). Many farm-workers

in Nepal and the Philippines subsequently offered their services in the construction sector as a means of re-establishing household incomes in the recovery period.

Another key barrier to achieving recovery is the trauma caused by the event. In the Philippines and Nepal, many disaster-affected individuals described struggling emotionally and psychologically during and after the event because of their fear of experiencing another disaster. This was in addition to the high levels of stress brought on by the enormous damage that the previous disasters had caused to their property and livelihoods. Some doubted their own emotional capacity to cope should another disaster occur.

Many individual coping mechanisms demonstrate impressive levels of emotional resilience. In the absence of external support, people in the Philippines and Nepal still took action to recover psychologically. This included spending time with family, friends and other community members to share experiences, seek and provide emotional support or engage in faith-based practices. Emotional support networks have been described as being fundamental to resilience, and as being both dependent upon and strengthened by strong and positive bonding capital. In combination with social support before, during and after a disaster, they supplement the emotional coping deposits that are depleted by 'pervasive stressors straining physiological stress responses, material resources and psychological well-being' (Graber et al., 2015: 18).

Adults have a fundamental role to play in the psychological recovery of their children in the aftermath of a disaster, although this may add to their own emotional burden (Graber et al., 2015; Salloum and Lewis, 2010). Yet there is evidence from the Philippines, Nepal and other post-disaster contexts that providing emotional support to children also helped adults to cope and recover (Salloum and Lewis, 2010). These actions adopted without the support of humanitarian agencies are invisible if we only explore and measure self-recovery through the shelter lens.

## 1.4. Directions of future research

Self-recovery is a relatively new area of research. It is apparent that it is complex, multifaceted and heavily influenced by the context in which it takes place. It is also clear that the way in which affected populations recover from disasters, with or without assistance, will shape their resilience. Continued research into self-recovery and support for it in different contexts is fundamental to a more detailed understanding of the phenomenon, and of how to support it better in practice.

It is important that more is done to understand the impact of a self-recovery approach on market behaviour, and consequently the structural resilience of housing repaired or reconstructed in the recovery period. Market swings are exacerbated after disasters that require widespread, or large-scale, reconstruction as they can cause localised price hikes until supply overtakes demand (Global Shelter Cluster, 2016). This may have serious implications for the resilience of post-disaster housing, impacting the availability of good quality materials as well as encouraging people to cut corners in the hope of making fewer resources go further or costing them out of the process altogether. As a self-recovery approach increasingly gains traction in the shelter sector, these market dynamics will need to be better understood.

Political and social structures exert a central influence on resilience by determining people's empowerment and ownership of their environment, but little is known about the influence of different governance regimes on shelter reconstruction (Curato, forthcoming), or how social relationships and socially constructed power dynamics shape recovery processes (Choudhury and Haque, 2016). Furthermore, research has focused on understanding self-recovery within the rural environment among assisted populations, leaving a gap in our knowledge about those who self-recover with no assistance and/or the implications of this process within urban contexts.

Future research on ways to facilitate knowledge transfer and to reconcile safer building with other recovery priorities will be important for increasing resilience to future disasters. Exploring subjective determinants of people's recovery trajectories and perceptions of resilience, particularly relating to values, along with perceived self-efficacy may provide interesting and important insights. Yet doing so requires the focus of the self-recovery debate to be widened beyond shelter to incorporate factors that may be more difficult to quantify and measure. This wider focus is crucial. From the perspectives of households recovering from disaster, the reconstruction of a home in isolation from the restoration of livelihoods and emotional well-being does not constitute recovery or resilience as promoted by the current policy narrative.

# 2. Resilience on Twitter: insights on influencers, networks and topics

## 2.1. Methods: 'listening in' on Twitter

Short-form social media platforms like Twitter offer opportunities to tune into conversations around research uptake and policy-influencing processes. The informality and the few participation barriers of the media lend themselves to potentially unlocking insights that would otherwise be unobtainable through traditional means of media monitoring. Social media are rapidly changing how research is communicated and the ways in which audiences engage with the communication process.

This section provides an analytical snapshot of:

- the key influencers generating and catalysing online conversations on resilience
- the popular topics in online conversations on resilience and the prominent themes
- the origins of the social media chatter on resilience, and who is talking to whom.

Seven datasets comprising Twitter conversations on or specifically relevant to resilience in the context of eight sectors (climate, disasters, agriculture, food security, conflict, urban, water, economic) were created using the Twitter API.[2] The datasets are analysed in two ways: content analysis (to explore thematic structures) and social network analysis (to map conversational and influence networks).

For each of the seven sectors, the analysis is summarised in three sections:

1. a word cloud showing the most frequently used terms on the concept of resilience in the sector (representing a visual snapshot of the thematic focus of these conversations)
2. a list of the most prominent discussion themes
3. a conversational social network map comprising nodes (which represent Twitter handles of organisations or individuals) and ties, which are the lines connecting the nodes (representing relationships and interactions).

The node size (or handle font size) helps the reader determine at a glance the key players in a network. The larger the node, the greater its influence in terms of organisational prominence and/or conversational interaction.

The maps show conversational clusters that represent who is talking to whom on the pertinent topic (e.g. climate and resilience), with the Twitter accounts of prominence often (but not necessarily) driving the conversations in the centre. The closer a node is to the centre of its conversational cluster, the more vocal or influential the player in question is in conversations on this topic in particular.[3] The crosscutting insights from this analysis are discussed at the end of the section.

2 An Application Programming Interface (API) is a way to get and work with data out of software applications and platforms.

3 It is worth noting that some Twitter handles can acquire temporary prominence in terms of perceived influence (during conferences or events, or at the time of publishing controversial news or opinion pieces, for instance). This is accounted for in the analysis.

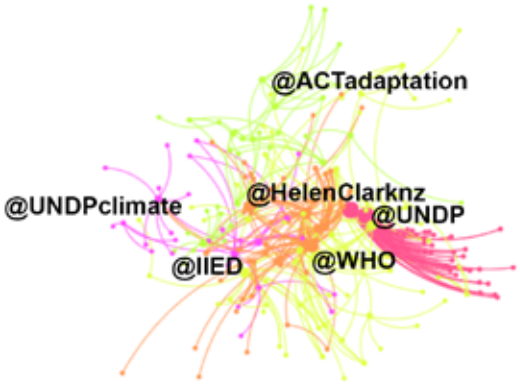
## 2.2. Climate resilience

Conversations on climate resilience focus on:

- technologies for climate-related disaster risk reduction
- climate adaptation strategies in different contexts
- ways to improve the resilience of the poorest and most vulnerable to climate risk
- supporting various indigenous communities to improve their climate resilience.

**Figure 1. Climate resilience word cloud**


**Figure 2. Network map of Twitter conversations on climate resilience**




### 2.2.1. What has changed since the last Scan?

Similar to the previous Scan, the climate resilience Twitter networks exhibit greater overlap with the water and food security resilience contexts than previous Scans. Some topics continue to feature prominently, such as ways to support indigenous, vulnerable and poor communities in order to improve their climate resilience.

### 2.2.2. Network map

Climate resilience network maps always show a very dense core of connected users. Conversations on climate resilience are the most thematically prominent compared to other sectors in the datasets analysed. This is also evident in the denser network maps of climate resilience Twitter conversations.

### 2.2.3. Top influencers on climate resilience

- @HelenClarkNZ: former Prime Minister of New Zealand and former @UNDP Administrator
- @UNDPclimate: United Nations Development Programme, climate change
- @WHO: World Health Organization
- @UNDP: United Nations Development Programme
- @ACTadaptation: Adaptation to Climate Change Team
- @IIED: International Institute for Environment and Development.

**Figure 3. Examples of climate resilience tweets**

**World Bank Climate**
@WBG_Climate

**#Africa** is one of the most vulnerable regions to **#climatechange**. **#Read** how countries are promoting **#resilience**: **wrld.bg/KEB030ap93W**

**A2R Initiative**
@a2rinitiative

Insights on building climate resilience through local stakeholder networks & community-based approaches to vulnerability & adaptive capacity http://bit.ly/2rmMKad

**Saleemul Huq**
@SaleemulHuq

Climate resilience can't be built through one-off workshops | Zilient **https://t.co/wAEmZepxl6**

## 2.3. Agriculture resilience

Conversations on agriculture resilience focus on:

- investing in smallholder farming to boost agriculture resilience
- agriculture innovation such as permaculture, automation and mechanisation and the use of solar energy
- the importance of biodiversity in strengthening agriculture resilience
- the impact of water shortages on farming
- the integration of approaches in farming, energy and sustainability to address resilience challenges.

### 2.3.1. What has changed since the last Scan?

Conversations on agriculture resilience continue to feature prominently. There is an increase in conversations on agriculture resilience in previously under-represented regional contexts, such as the Caribbean region (the African regional context had the most visibility in most previous Scans).

### 2.3.2. Network map

The agriculture resilience network maps are less dense and more fragmented than the climate resilience map. As with the climate resilience networks, conversations are driven by a few larger nodes, but with less interaction from wider relevant sub-networks. This shows that agriculture resilience has a relatively limited cross-thematic relevance compared to other sectors.[4]

### 2.3.3. Top influencers on agriculture resilience

- @FAOknowledge: Food and Agriculture Organization of the United Nations (FAO)
- @IFPRI_KM: research tweets from International Food Policy Research Institute
- @open_resource: open debates, ideas and initiatives on the future of resources and ways to protect it (account by @suez)
- @AgriFoodAID: cluster consortium that provides expert training across the agrifood supply chain in sub-Saharan Africa
- @@PEDRRnetwork: The Partnership for #Environment and #Disaster #Risk #Reduction is a #global alliance of 21 #UN agencies, NGOs and specialist institutes.
- @CIAT_Africa: sharing @CIAT_ research from Africa.

**Figure 4. Agriculture resilience word cloud**

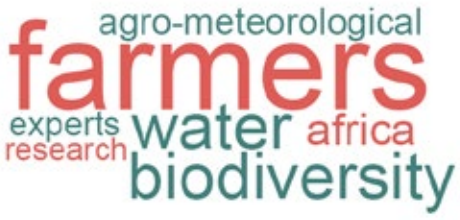



**Figure 5. Network map of Twitter conversations on agriculture resilience**

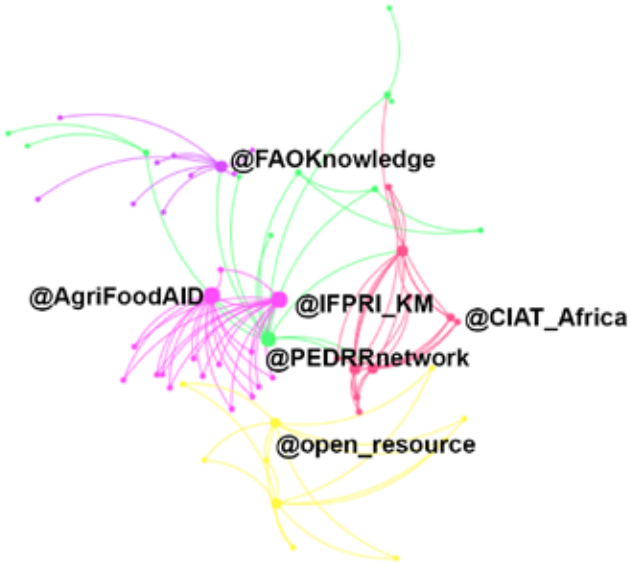



**Figure 6. Examples of agriculture resilience tweets**

**Tonya Haigh**
@TonyaHaigh

Is crop insurance policy eroding the resilience of agriculture? **http://bit.ly/2rm07pm**

**Megan Rowling**
@meganrowling

"#Agriculture is a part of global security politics," says German minister as G20 commits to boost #resilience of #water bodies key for food **http://bit.ly/2rmlmlq**

4 While the Twitter network analysis offers a useful snapshot of prominent themes in the period during which the data was collected, it is not always possible to have an objective measure of comparative thematic prominence due to the fairly large degree of thematic overlap across several sectors (e.g. the agriculture, food security and water sectors).

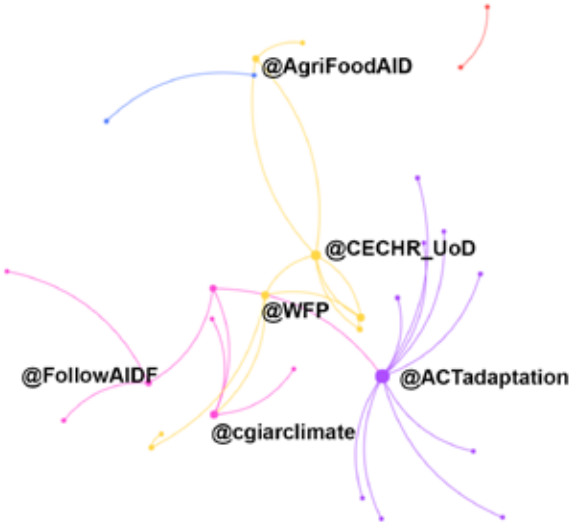
## 2.4. Food security resilience

Conversations on food security resilience focus on:

- the importance of food security and nutritional adequacy to promote community well-being
- the role of innovative agriculture techniques and new scientific approaches in preventing food shortages
- climate change disruption of food security resilience
- the integration of climate, water and agriculture policies
- developing resilient food systems in disasters.

**Figure 7. Food security resilience word cloud**


**Figure 8. Network map of Twitter conversations on food security resilience**




### 2.4.1. What has changed since the last Scan?

Food security resilience is perhaps the sector with the most overlap with the other resilience sectors, most importantly climate, agriculture, water and urban resilience. This is particularly pronounced in this Scan. There is greater focus on food systems for disasters, shocks and stresses, as well as on farming for stronger food security resilience.

### 2.4.2. Network map

Similar to agriculture resilience, food security resilience networks are comparatively sparse, with conversational clusters that are fewer in number and further apart, and with little connections across communities.

### 2.4.3. Top influencers on food security resilience

- @CECHR_UoD: Centre for Environmental Change and Human Resilience
- @FollowAIDF: Aid and International Development Forum
- @ACTadaptation: Adaptation to Climate Change Team
- @cgiarclimate: CGIAR Research Program on Climate Change, Agriculture and Food Security
- @WFP: World Food Programme.

**Figure 9. Examples of food security resilience tweets**

**Mikell O'Mealy**
@mikellomealy

In Asia, 60 to 90% of water is used for agriculture, making **#climate** resilience essential for **#foodsecurity**. **https://t.co/dTxDsoM6pD**

**Center 4 Food Safety**
@CFSTrueFood

Only agricultural diversity can ensure **#foodsecurity** and resilience. **#climatechange** **https://t.co/bNMaarLJwa**

**CCRN**
@CCRN_news

Livelihood diversification can greatly improve **#resilience** to a changing **#climate** & protect communities @Greenpeace **#drought** **#foodsecurity**

**http://bit.ly/2rndsQ7**

## 2.5. Conflict resilience

Conversations on conflict resilience focus on:

- ways to enhance the resilience of vulnerable communities to conflict
- the impact of food and water shortages on conflict resilience
- waves of population displacement and migration caused by weakened conflict resilience
- strengthening resilience in contexts of protracted and intractable violence.

**Figure 10. Conflict resilience word cloud**

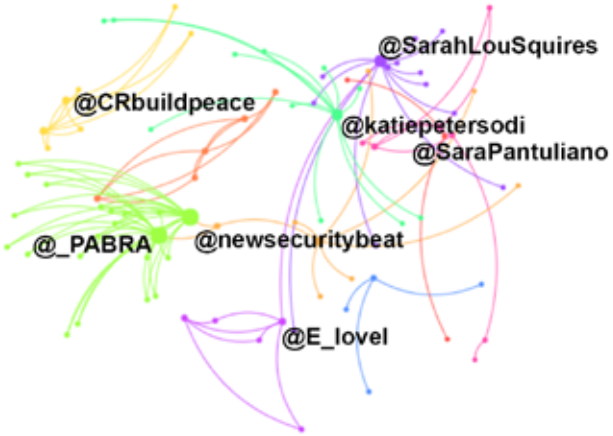

### 2.5.1. What has changed since the last Scan?

In this Scan, conversations on conflict resilience show more interest in migration, displacement and refugee movement triggered by war and violence. There are also more prominent thematic overlaps with the food security, water and urban contexts.

### 2.5.2. Network map

The conflict resilience network maps show a relative increase in modularity[5] compared to previous scans, which highlights a rising interest in conflict- related resilience conversations.

**Figure 11. Network map of Twitter conversations on conflict resilience**




### 2.5.3. Top influencers on conflict resilience

- @SarahLouSquires: Sarah Squires, Senior Communications Officer @Gens_For_Peace
- @CRbuildpeace: Conciliation Resources is an independent international peace-building organisation
- @katiepetersodi: Katie Peters, Research Fellow, ODI
- @E_lovel: Researcher @ODIdev on disaster risk reduction, climate, resilience, gender and social inclusion
- @newsecuritybeat: Blog of @TheWilsonCenter's Environmental Change and Security Program
- @ _PABRA: The Pan-Africa Bean Research Alliance, a network of national research centres in 30 countries providing better beans for Africa
- @SaraPantuliano: Managing Director @ODIdev. Humanitarian Policy Group.

**Figure 12. Examples of conflict resilience tweets**

**Arrey Elvis Ntui**
@ArreyMcNtui

Development partners must quickly shift to build recovery and resilience for **#conflict** weakened Far North **#Cameroon**

**BRW**
@BR_Workshop

Nathan Morrow: **#foodsecurity #resilience** and **#conflict** are hugely interconnected. Need to be willing to focus on this. **#foodsafety #rescon17**

**FVPLS Victoria**
@FVPLSVictoria

"building **#resilience** to reduce **#vulnerability** to **#violence**" Our CEO **@BraybrookA** is speaking **@VicHealth #preventionispossible #forum** today

5 Modularity is a measure of the extent a network is divided into modules, or groups and the relative density of connections within those groups. In the context of this analysis, a higher modularity means denser connections between handles in the same (thematic) network, which indicates more tweets or conversations on, and consequently rising interest in, the theme.

## 2.6. Urban resilience

Conversations on urban resilience focus on:

- the impact of climate change on urban resilience
- the role of design and innovation in building more resilient cities
- spatial justice
- ways to strengthen urban resilience against disasters and natural hazards
- ways to strengthen the resilience of vulnerable urban communities
- integration of displaced communities in urban contexts.

**Figure 13. Urban resilience word cloud**

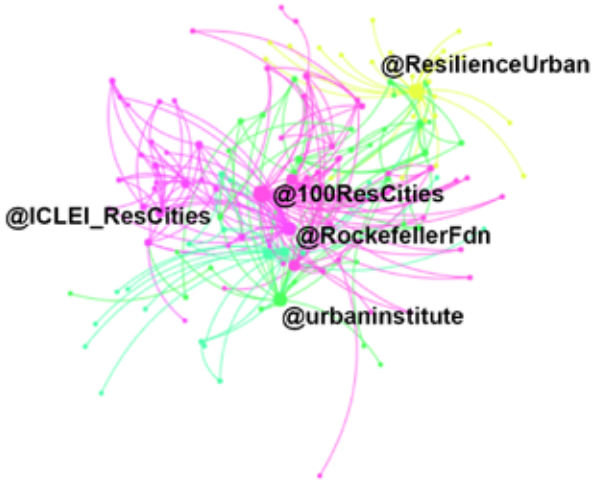

### 2.6.1. What has changed since the last Scan?

Conversations on innovative design, technology and engineering to strengthen urban resilience continue to feature prominently in urban resilience.

### 2.6.2. Network map

Similar to the conflict resilience sector, urban resilience shows denser networks compared to previous scans, but with few interactions outside the conversations driven by a few influential handles (expert and NGO handles show less interaction with design, engineering and science handles compared to some previous scans, for example).

**Figure 14. Network map of Twitter conversations on urban resilience**




### 2.6.3. Top influencers on urban resilience

- @ResilienceUrban: Urban Resilience, Barcelona-based enterprise with the main objective of providing solutions to current mobility problems, such as traffic congestion and pollution.
- @100Rescities: 100 Resilient Cities – Project by @RockefellerFdn helps cities become more resilient to the shocks and stresses of the 21st century
- @RockefellerFdn: The Rockefeller Foundation's mission – unchanged since 1913 – is to promote the well-being of humanity throughout the world.
- @urbaninstitute: Elevating the debate on social and economic policy since 1968.
- @ICLEI_ResCities: Resilient Cities is the leading global forum on urban resilience.

**Figure 15. Examples of urban resilience tweets**

**Alexandra Tsatsou**
@AlexTsatsou

**#Urban** space & **#disaster**, building **#resilience** with **#communities** Applications open **#Nepal #India #Bhutan #Bangladesh http://tinyurl.com/hena6a7**

**imbybio**
@imbybio

What is green infrastructure? Reducing and treating stormwater at its source **#urban #resilience https://soamp.li/2sjS** via **@EPA**

**Holly M. Mayton**
@hollindaze

Why should cities care about **#urbanag**? Community resilience and sustainability! **@SustCitiesInst #GrowRiverside**

## 2.7. Water resilience

Conversations on water resilience focus on:

- clean water infrastructure in urban and rural contexts
- strengthening water resilience of communities in flood and drought-prone areas
- impact of access to water for agriculture on food security
- water management strategies intended to improve water resilience.

**Figure 16. Water resilience word cloud**

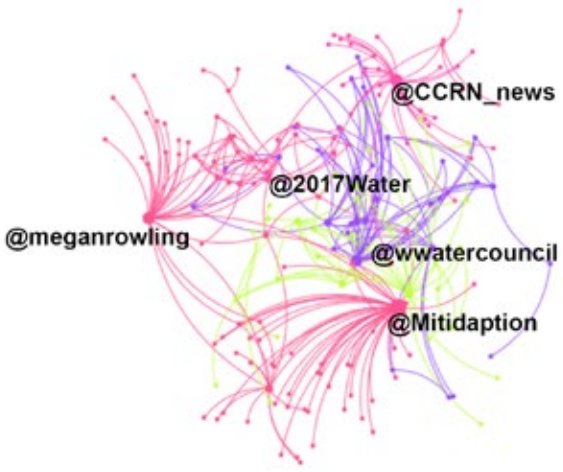

### 2.7.1. What has changed since the last Scan?

Conversations on droughts, floods, access to water for drinking and agriculture still feature most prominently, and thematic overlaps with the urban, food security and agriculture contexts remain. There are more conversations on clean water infrastructure in cities.

### 2.7.2. Network maps

Water resilience networks exhibit a community structure similar to, if not as dense as, climate resilience. They feature largely expert-driven conversations with increasing overlap with conflict, agriculture and food security networks.

**Figure 17. Network map of Twitter conversations on water resilience**




### 2.7.3. Top influencers on water resilience

- @CCRN_news: Community Conservation, an international partnership of aboriginal, community, government, NGOs and researchers using social-ecological systems to study community-based conservation
- @2017Water: Water 2017 is a one-year effort to encourage the next [sic – incumbent] US President and Congress to prioritise global water security
- @wwatercouncil: World Water Council
- @meganrowling: Megan Rowling, journalist with Thomson Reuters Foundation
- @Mitidaption: Mitidaptation, Research on climate change risks to business, governance and society.

**Figure 18. Examples of water resilience tweets**

**World Bank Pubs**
@WBPubs

Only 3% of the Earth's **#water** is fresh. How to boost **#resilience** to **#waterscarcity**? Report: **http://wrld.bg/vSap3002u8Q**

**SW@UN**
@SWDayUN

Bolivian farmers are realizing the effects of **#climatechange** through **#water #shortage**. Learn about their **#resilience**

**https://t.co/NhaGwezMFA**

**Stuart Khan**
@stukhan

Essential water infrastructure often fail during extreme weather events. We must address climate change, build resilience or get used to it.

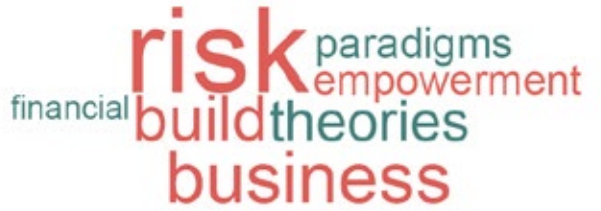
**http://bit.ly/2rn2F8A**

## 2.8. Economic resilience

Conversations on economic resilience focus on:

- the role of the private sector in strengthening economic resilience
- strategies aimed at bolstering economic resilience in different contexts
- ways to improve disaster recovery by focusing on economic resilience strategies
- migration, displacement and economic resilience.

**Figure 19. Economic resilience word cloud**



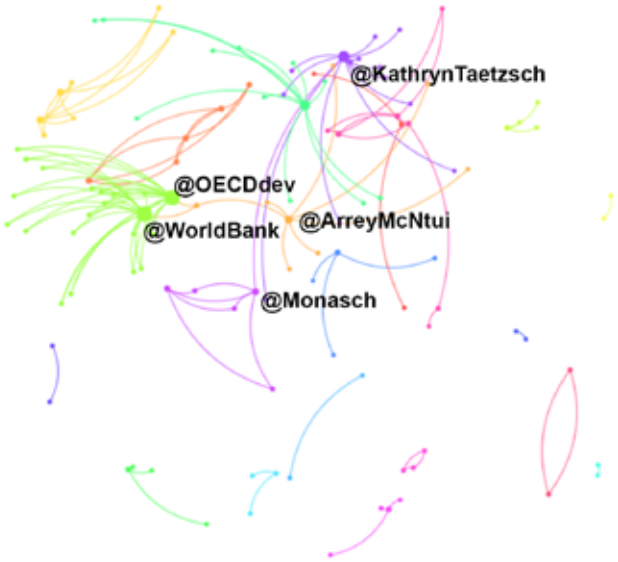

### 2.8.1. What has changed since the last Scan?

The economic resilience sector continues to be thematically diverse. Conversations on the role of economic resilience in contexts experiencing migration and displacement are more visible compared to previous Scans.

### 2.8.2. Network map

Still comparatively sparse, but exhibiting a relatively high degree of thematic diversity, economic resilience network maps show fewer conversations across scattered communities.

**Figure 20. Network map of Twitter conversations on economic resilience**




### 2.8.3. Top influencers on economic resilience

- @WorldBank: The World Bank
- @KathrynTaetzsch: Dr Kathryn Taetzsch, researcher on local resilience in light of increasing frequency, complexity of disasters
- @OECDdev: Organisation for Economic Co-operation and Development
- @ArreyMcNtui: Arrey Elvis Ntui, economist, author of Murdering poverty: How to fix aid.

**Figure 21. Examples of economic resilience tweets**

**Philip Thigo**
@pthigo

**@sidchat1** : Economic resilience & interdependence will be the driver to **#economic #prosperity** in **#Kenya**. **@UNinKENYA @UNDPKenya**

**Kathryn**
@KathrynTaetzsch

**#AIDFAfrica #disaster #recovery** thru **#economic #resilience** building - why **#partnerships** with **#connectbiz** & 4 local **#Biz4HumDevImpact** matter!

**http://bit.ly/2raV6Te**

**OECD**
@OECD

Strengthening **#economic** resilience: What lessons can we draw from post-70s severe recessions & financial crises? See **http://bit.ly/2kPiPF1**

## 2.9. Conclusions

### 2.9.1. What does Twitter talk about when it talks about resilience?

As in previous Resilience Scans that focused on Twitter, climate resilience dominates the conversation and displays far-reaching thematic overlap with other resilience contexts. In this Scan, conflict resilience conversations have lower visibility compared to the previous Scan, while urban and food security resilience conversations are more visible. The remaining contexts have experienced little fluctuation in terms of conversational visibility since the last Scan. Themes of technology, innovation and context-appropriate solutions still feature as common denominators across all sectors.

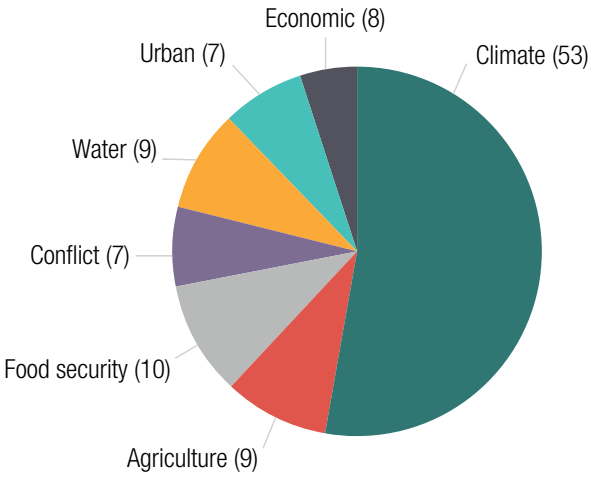
### 2.9.2. Who tweets about resilience?

Institutional voices continue to enjoy the widest discursive visibility, largely because of the professional social media management resources that most institutions employ, but more individual experts and academics are joining the conversations and acquiring their share of discursive visibility.

### 2.9.3. How is resilience tweeted about?

The dominant mode of tweeting about resilience is expert-driven, formal and more link-broadcasting than discursively interactive, so a defining feature of these conversations remains the expert/institution 'echo chamber' effect. Aside from a few exceptions, there is little engagement between top Twitter resilience experts and wider Twitter communities that may be relevant to resilience themes, but which do not focus specifically on resilience. Additionally, most conversational clusters are driven by a few very central and visible influencers, as a comparison with previous Scans' conversational networks confirms. There is significant overlap between several topic networks, such as the water and agriculture sectors and the conflict and food security sectors.

**Figure 22. Thematic distribution of Twitter conversations on resilience**




It is important to note that this Resilience Scan's look at Twitter adopts a topic-driven approach, offering a snapshot of contexts, themes and influence at certain points in time. The network maps and conversational clusters generated from the datasets represent the accounts which are relatively influential within certain contexts in the period during which the data were gathered. These networks are in constant flux, and 'influence', as a measure of impact of topic communication and of who is driving the conversations, is constantly changing. Additionally, episodic spikes in the conversational visibility of certain themes often occur due to events such as academic and professional conferences.

# 3. Resilience in the grey literature

Our examination of the grey literature on resilience published in January–March 2017 includes 24 articles from research and private sector institutions, as well as humanitarian and development agencies. These span six broad themes:

1. agriculture and food security
2. social inclusion and protection
3. conflict and security
4. disasters and climate resilience
5. urban and infrastructure resilience
6. measurement and resilience.

Compared to the last quarterly Scan (October–December 2016), more publications discussing agriculture and food security have been selected and there are fewer studies of Agenda 2030.

## 3.1. Agriculture and food security

Grey literature on agriculture and food security suggests:

- There are advantages in using a 'landscape approach' – which recognises the complexity of land management systems and the need to consider human–environment interactions across sectors and scales – to manage and build the resilience of natural resources.
- There is a need to increase agricultural productivity, food production and value addition to satisfy the demand for food and decrease dependence on food imports in sub-Saharan Africa.
- It is important to build food security and nutrition resilience through peace-building efforts that aim to protect, save and rebuild lives and agricultural livelihoods impacted by conflict.
- There is a disparity between producers and end markets (both international and national), resulting in producers being subject to inequitable price conditions and incurring high transactional costs.

Agriculture and food security represent a well-discussed theme in the grey literature from January to March 2017, featuring seven papers. The FAO and Asian Development Bank (ADB) both present their organisational approaches to building agricultural resilience (FAO, 2017a; Critchley and Radstake, 2017), and two further publications conduct regional level assessments of food security and nutrition in Africa (FAO, 2017b) and the impact of climate change on the agriculture and tourism sector in the Caribbean (CDKN, 2017). At the national level, one publication maps multiple value chains for products such as beef in Senegal and cotton in Pakistan (Carabine and Simonet, 2017). The final two publications discuss agricultural resilience and climate change adaptation (CCA) at the household level in Rwanda (Rugege and Vermeulen, 2017) and Uganda (Chaplin et al., 2017).

Critchley and Radstake (2017) present ADB's newly developed landscape approach as a means of achieving the fourth priority area of ADB's Operational Plan for Agriculture and Natural Resources, 'Enhancing management and climate resilience of natural resources'. This approach recognises the complexity of land management systems and the need to consider human–environment interactions across sectors and scales. The publication asserts that management and climate resilience are firmly imbedded in sustainable land management (SLM) and can be enhanced and scaled-up by adopting a landscape approach. This work provides case studies from rural areas of Asia to explain how the landscape approach, underpinned by SLM, can be used to allocate and manage land to achieve multiple social, economic and environmental objectives in areas with competing land-use, environmental and biodiversity goals. The study also discusses different technologies for managing the landscape, methods of assessing these technologies, the implications of the landscape approach for investment opportunities and the national and international level

*The approach recognises the complexity of land management systems and the need to consider human-environment interactions across sectors and scales.*

support that can facilitate and incentivise these investments (Critchley and Radstake, 2017).

FAO (2017a) also presents its resilience approach, focusing particularly on agricultural livelihoods and the shocks that they face, including natural hazards and climate-related disasters, food chain crisis, and conflict and protracted crisis. FAO adopts a multi-hazard and cross-sectoral approach to action across four mutually reinforcing action areas: (1) governing crisis and disaster risk, (2) monitoring crisis and disaster risk with early warnings, (3) preparing for and respond to crises and disasters, and (4) reducing community vulnerability to crises and disasters. The report describes FAO's regional and national resilience-building initiatives that represent each of these four areas, with examples from South Sudan, Madagascar, Somalia, Namibia and Central America.

Another study from FAO provides an overview of the state of food security and nutrition in Africa in 2016 (FAO, 2017b). Assessments in sub-Saharan Africa show that 26% of the population over the age of 15 suffered from severe food insecurity in 2014 and 2015. After having increased slightly in sub-Saharan Africa over the last three decades, food production has remained stagnant for the last five years, indicating increased reliance on food imports to increase food availability. There is therefore a substantial need for an increase in agricultural productivity and food production to satisfy the demand for food. With the region suffering from the triple burden of malnutrition, undernutrition and obesity, there is a need to integrate nutrition into agriculture. The study advocates a multi-sectoral and multi-disciplinary approach to integrating agriculture, nutrition and social protection. Finally, it highlights the importance of building food security and nutrition resilience through peace-building efforts that aim to protect, save and rebuild agricultural livelihoods and lives impacted by conflict.

Another regionally focused publication identifies some of the most pressing climate vulnerabilities facing the agricultural and tourism sectors of the Caribbean (CDKN, 2017). This policy brief highlights that more intense and short-lived rainfall, as well as overall warmer conditions and longer drought events, will have a significant impact on the growing season and the optimal location of many key crops. The tourism sector is projected to be particularly hit by hurricanes and coastal inundation, with 94% of tourist accommodation facilities located at lower coastal elevations. The policy brief advocates a number of agricultural adaptation activities, including: (1) crop diversification or substitution, (2) irrigation and mechanisation, (3) monitoring of growing areas and plan for land-use change, (4) improving education on sustainable farming practices, and (5) adoption of micro-insurance. In terms of adaptation within the tourism sector, the brief advocates planning regulations that restrict building to areas at least 2.6 m above mean sea level and 30 m above the high-tide mark, as well as several disaster-preparedness measures.

*Being a member of a local formal or informal group such as an agricultural, religious or women's group was positively associated with a household's ability to adapt to climate change*

Moving from the regional to the national scale, Carabine and Simonet (2017) provide analysis of value chains in drylands as part of the Pathways to Resilience in Semi-Arid Economies (PRISE) research project. The report maps the value chains of cotton in Pakistan and Burkina Faso, beef in Senegal and two regions of Kenya, and cow's milk in Senegal. The mapping exercise found a disparity between producers and end markets (both international and national) for all six value chains, suggesting that producers are subject to inequitable price conditions and incur high transaction costs. The synthesis report indicates opportunities for improved efficiency along the chains by supporting vertical integration. In all value chains but one, there was significant potential to upgrade processing to add value and to provide additional socioeconomic benefits, including employment opportunities. Pakistan is the exception, as it has a well-developed textile industry, which suggests there are opportunities for vertical transformation of these value chains reducing constraints of production and international level markets. Some of the other common major constraints were poor infrastructure, inadequate provision of financial services, limited access to markets for producers and lack of appropriate regulations.

The final two publications within this grey literature section discuss household and farmer resilience. Despite their slightly different focus, both reports assessed levels of climate information among the households. Drawing on a household-level analysis in the Karamoja region of Uganda, Chaplin et al. (2017) establish that droughts and/or prolonged dry spells were the most common climatic shock over the last five years. However, nearly two thirds of the household respondents had not perceived any changes in climate, and half do not think the climate will continue to change over their lifetime. The authors found that both being a member of a local formal or informal group (such as an agricultural, religious or women's group), and access to climate information were positively associated with a household's ability to adapt to climate change. Moreover, the report found that the most common sources of this climate information came from own or indigenous knowledge.

*The nature of adaptation to climate change is inextricably linked to the communities that it affects*

Drawing on a purposive sampling survey of farmer cooperatives in Rwanda, Rugege and Vermeulen (2017) found an overall appreciation for the value of and need for weather information, as well as an understanding of the value of seasonal advice bulletins over daily weather forecasts. The farmer-scientist participatory on-farm trials were reported as successful in identifying climate resistant potato and maize varieties, though on-farm participatory trials of climate resistant forage varieties did not indicate satisfactory yields or generate farmer confidence. Chaplin et al. (2017) conclude with seven recommendations: (1) encourage water harvesting and conservation schemes, (2) synergise dissemination of climate information services with existing information systems, (3) sensitise households to the threat posed by climate change, (4) put gender mainstream in climate change related initiatives, (5) improve access to climate information services, (6) encourage agro-forestry schemes, and (7) increase membership to formal and informal village groups.

## 3.2. Social inclusion and protection

Grey literature on social inclusion and social protection suggests:

- the nature of adaptation to climate change is inextricably linked to the communities that it affects
- adaptation actions are most effective and sustainable when they are imbedded in local governance systems that have the capacity and flexibility to identify risks and respond accordingly
- the need to acknowledge the disproportionate impacts of disasters, climate change, conflict and violence for women and girls during humanitarian crises and in emergency relief and recovery efforts
- the importance of women's capacity as active agents in humanitarian action and resilience building, as well as their 'front line' knowledge of the local environment and local-level risk.

Three publications discuss social inclusion and protection, with two focusing on local institution and government ownership of social protection and CCA initiatives (Bugler and Palin, 2017; WFP, 2017). The third study notes the disproportionate impact of climate change on women and girls, as well as their agency and capacity to contribute to and lead humanitarian and resilience-building initiatives (ActionAid, 2017).

Bugler and Palin (2017) examine the ways in which policy-makers can coordinate adaptation interventions at the local level with multiple partners across jurisdictional scales. The briefing paper provides research and case studies from across the Caribbean to examine four approaches to help empower communities to take control of local adaptation processes: (1) analysing, understanding and fostering networks of local actors that can work collaboratively to build climate resilience, (2) understanding local-level vulnerability through community-based vulnerability assessments, (3) assessing adaptive capacity at the local level, and (4) connecting local action with regional and national decision-making. The briefing paper explains each approach and provides a framework and case studies for all four. It concludes by highlighting that adaptation to climate change is, to a large extent, a local process that must be sensitive to the local context. Adaptation actions are most effective and sustainable when they are imbedded in local governance systems that have the capacity and flexibility to identify risks and respond accordingly.

WFP (2017) presents an initiative in the Middle East and North Africa (MENA) region which aims to enhance the effectiveness and broaden the coverage and impact of school meal programmes as a key social protection instrument to support poor and vulnerable children. The initiative supports national governments and institutions to enhance the quality and sustainability of national programmes and link them to local economies and agriculture so as to contribute towards the achievement of the Sustainable Development Goals (SDGs). This publication presents the results of a multi-stakeholder meeting held in 2016 which resulted in a shared vision for an MENA regional initiative for school meals and social protection.

The ActionAid (2017) report demonstrates the capacity of women to take leadership roles in a variety of resilience-building initiatives, drawing on case studies from Bangladesh, Cambodia, Kenya, Liberia, Malawi, Myanmar, Senegal, Sierra Leone, Vietnam and Zimbabwe. The report highlights the disproportionate impacts of disasters, climate change and conflict-led exacerbation of violence against women and girls during humanitarian crises and in emergency relief and recovery efforts. This increased gendered vulnerability is not natural and is caused by social and economic disadvantage as a result of the social construction of gender roles, systematic discrimination and the power imbalance between women and men. The report highlights women's capacity as active agents in humanitarian action and resilience building as well as their 'front line' knowledge of the local environment, including a good understanding of local-level risk which can be used to determine effective resilience building activities. Case studies from Vietnam show women demanding local authorities recognise and

protect their right to forest land, and in Malawi women are leading the larger community in a transition to agroecological farming practices.

## 3.3. Conflict and security

Grey literature on conflict and security suggests:

- the need for a conflict-sensitive approach to building resilience – that is, an approach which is designed to minimise negative and maximise positive impacts of planned adaptation and resilience interventions in situations of conflict and peace.
- organisations engaged in the Syrian crisis consider persons with disabilities as homogenous, and therefore fail to effectively identify those most in need within the population of persons with disabilities
- protection assessments fail to consider the resources, skills and assets that people possess, focusing instead on the negative capacity of persons with disabilities
- the lack of vulnerability- or resilience-based literature that focuses on youth as a specific cohort.

The START Network (2017) provides methods aimed at humanitarian and development practitioners for strengthening resilience in conflict-affected states. The Women's Refuge Commission (2017) discusses vulnerability- and resilience-based approaches in the context of refugees with disabilities.

The START Network (2017) has produced a guide that provides practical support to humanitarian and development practitioners working on resilience strengthening in conflict-affected contexts. The guide uses learning and best practice from consortium partners to develop an integrated methodology for strengthening resilience in such situations. As well as introducing core concepts (conflict, violence and resilience) and their cross-cutting considerations and complexities, the guide provides examples of best practices and lessons learned structured around the typical project cycle, with a focus on: (1) conflict analysis, (2) planning and preparation, (3) action planning, (4) conflict-sensitive implementation and monitoring, and (5) conflict-sensitive monitoring and evaluation. The publication highlights the need for a conflict-sensitive approach which understands the conflict context and the potential for integration between planned action and this context. A conflict-sensitive approach also includes the need to minimise negative and maximise positive impacts of planned adaptation and resilience interventions in situations of conflict and peace.

Drawing on an extensive literature review and a review of a pilot project with adolescents and youth in Iraq and Lebanon, the Women's Refuge Commission (2017) examines how vulnerability- and resilience-based

A women's group in Mongla, a village on the climate change front line in Bangladesh. Photo credit: Eleanor Church/CAFOD, 2012. CC BY-ND-NC 2.0.

approaches support the protection and empowerment of Syrian refugee women, children and youth with disabilities. The report found that most organisations engaged in the Syrian crisis consider persons with disabilities as a homogenous group, and therefore fail to effectively identify those most in need within the population of persons with disabilities. Reflecting the findings of ActionAid (2017) in the inclusion and social protection theme, this report notes that protection assessments fail to consider the resources, skills and assets people possess, and focus instead on the negative capacity of persons with disabilities. Finally, the report highlights the lack of vulnerability- or resilience-based literature focusing on youth as a specific cohort.

## 3.4. Disasters and climate resilience

Grey literature on disasters and climate resilience suggests:

- analysis in fragile and conflict-affected countries reveals that shocks to national economic growth can be absorbed within the first year following a disaster, but lead to negative impacts three years later
- more in-depth analysis is needed to assess the impact of aid on countries' economic recovery processes following shocks
- the need to increase investments that initiate transformative changes in market, ecological and governance systems
- low levels of urban adaptive strategies require local city authorities and NGOs to work together to provide transparent information and assistance services to households living in flood-prone areas.

Disaster and climate resilience represent the second most prominent theme in the grey literature this quarter, with five publications. Two describe organisational strategy and response to natural hazards in a variety of countries around the world (GFDRR, 2017; UNDP, 2017). The other three publications discuss building resilience to various hydro-meteorological hazards, such as droughts and floods (Mercy Corps, 2017; Simonet et al., 2017; Urban ARK, 2017).

GFDRR (2017) summarise its activities and achievements from 2014 to 2016 under Result Area 2 of the programme on building resilience to natural hazards in sub-Saharan Africa, across both countries and communities: African Regional Economic Communities have operational disaster risk reduction (DRR) coordination, planning and policy advisory capacities to support their respective member states and regional and sub-regional programmes. The United Nations Development Programme (UNDP, 2017) presents responses

*The study found that shocks in BRACED countries were absorbed in the first year following the disaster, but that three years on from the disaster there was a negative impact on economic growth*

to the impacts of the El Niño and La Niña phenomena in 2015 and 2016. The report details their impact on different countries around the world as well as the investment requirements to effectively respond and build resilience. UNDP describe their strategy as being a synergy between humanitarian and development activities, including 1) Information, early warning/action and preparedness, 2) Immediate response and resilient recovery to stabilise livelihoods, build systems and institutions and 3) disaster and climate resilience-building to address underlying vulnerabilities.

Three studies deal with resilience to hydro-meteorological hazards. Like UNDP, Mercy Corps (2017) discusses the 2015–2016 El Niño phenomenon and presents findings from a study measuring the effectiveness of its Pastoralist Areas Resilience Improvement through Market Expansion (PRIME) programme to cope with the El Niño-related drought event in the Somali region of Ethiopia. The study also found that households that had benefited from the PRIME project were better able to maintain food consumption, assets and livestock health. However, the study found that the PRIME households and comparison households used similar types and levels of response mechanisms to manage the effects of the drought. There was no difference between the shocks experienced by each group, suggesting that the PRIME programme did not enable households to use adaptive practices to avoid being affected by shocks in the first place. The study therefore concludes by recommending that greater support be provided to approaches and investments that can initiate transformative changes in the market, and to ecological and governance systems that underpin people's ability to manage shocks and stresses.

Simonet et al. (2017) consider the broader and long-term impacts of these hazards on national economic resilience, whereas Mercy Corps (2017) and Urban ARK (2017) assess the impacts and methods of building resilience to specific drought and flood events. Simonet et al. (2017) provide an analysis of national economic resilience over a 42-year period across 12 countries in the Sahel, East Africa and Asia that are part of the Building

Resilience and Adaptation to Climate Extremes and Disasters (BRACED) programme.[6] The statistical analysis from 1970 to 2012 found that, when compared with other groups of developing countries, BRACED countries were disproportionately affected by disasters, particularly those related to hydro-meteorological hazards. The study found that shocks in BRACED countries were absorbed in the first year following the disaster, but that three years on from the disaster there was a negative impact on economic growth. Possible explanations provided for this are an increase in aid through the first year following a disaster followed by the withdrawal of the aid, or an incapacity of countries to smooth aid flows over time. The analysis also highlights the disproportional attention paid to larger, rarer events over smaller frequent events, as well as the need for a more in-depth analysis to assess the impact of aid on countries' economic recovery processes.

Finally, an Urban Africa Risk Knowledge briefing outlines a new methodology for investigating aspects of resilience in very poor urban contexts (Urban ARK, 2017). This was developed as an urban-focused version of the rural food security monitoring tool, the household economy approach. The new methodology was applied in Niamey, Niger, and this briefing presents the methods, findings and lessons learned through its implementation. The results indicate low levels of resilience among flood-exposed households characterised by inequalities in social capital ties and variable access to food and security post-flood. However, the assessment found that bothhouseholds with both low and high resilience had very few adaptive strategies to cope, and rarely reported their situation to the authorities or received advance information about flood risk and management. These results suggest the need for the local city authorities and NGOs to work together to provide transparent information and assistance services to households living in flood-prone areas (Urban ARK, 2017).

*The report describes how the insurance industry can play a key role by working in partnership with other stakeholders to improve city infrastructure*

## 3.5. Urban and infrastructure resilience

Grey literature on urban and infrastructure resilience suggests:

- the insurance industry can play a key role in supporting resilience-building approaches by working in partnership with other stakeholders to improve city infrastructure
- opportunities for the private sector to invest in urban resilience span water management, big data management, innovative financing and technologies for community engagement.

Three publications in the grey literature this quarter discuss urban and infrastructure resilience. Two discuss building climate resilience through critical urban infrastructure systems (Lloyd's and Arup, 2017; Tran, 2017), whereas one highlights specific opportunities from new technologies and emerging sectors (100 Resilient Cities, 2017).

Lloyd's of London and Arup present a new set of principles to guide the planning, design, construction and operation of some of the key components of city infrastructure and to improve resilience (Lloyd's and Arup, 2017). The report focuses on four critical infrastructure systems: energy, water supply, information communications technology and transport. It identifies three approaches to building urban infrastructure resilience after a shock or stress event: (1) preventing failure – ensuring infrastructure systems can withstand the direct and indirect impact of disasters through individual components that can fail temporarily to preserve the overall system function, (2) expediting recovery – supporting infrastructure systems to become functional again as soon as possible after stress or collapse, and (3) transforming performance – working towards a new and improved state rather than 'bouncing back' to business as usual, requiring reflection, learning and growing. The report describes how the insurance industry can play a key role in supporting these measures by working in partnership with other stakeholders to improve city infrastructure.

Tran (2017) applies ISET-International's Urban Climate Resilience Planning Framework (UCRPF) in the context of critical urban infrastructure systems. The analysis emphasises the role of urban agents and institutions in building climate resilience. The UCRPF is presented as containing three broad components: a focus on shared learning and the need for communication and the development of common understanding among diverse groups; analytical approaches capable of addressing the diverse components that make up urban areas; and

6 BRACED countries studied include: Burkina Faso, Chad, Ethiopia, Kenya, Mali, Mauritania, Myanmar, Nepal, Niger, Senegal, Sudan and Uganda.

a specific yet flexible set of process considerations and supporting activities that can assist urban areas in planning capacity, building, implementing and learning (Tran, 2017).

A study written as part of the 100 Resilient Cities initiative presents the evolving demands of resilient cities as a means of sending a signal to the private sector and demonstrating the tools and services needed (100 Resilient Cities, 2017). It describes specific opportunities for the private sector to invest in increasing urban resilience through four major areas: (1) water management (e.g. multi-purpose green infrastructure that controls flooding and repurposes rain-water), (2) big data management (e.g. digital community communication platforms and increased quality and capacity of city information systems), (3) innovative financing (e.g. alternative risk transfer arrangements and increased private sector participation in building urban resilience), and (4) technologies for community engagement (e.g. communication platforms on risk and resilience for citizens and high-speed internet service for low income communities).

## 3.6. Measurement and resilience

Grey literature on measurement and resilience suggests:

- the three capacities of resilience (absorptive, adaptive and transformative) are all essential for resilience, and are interconnected and mutually reinforcing
- the need to determine the frequency of resilience measurement required to capture the dynamic nature of resilience
- the need to consider international developments when assessing a country's vulnerabilities
- the need for robust methods of quantifying the resilience benefits of natural ecosystem services.

The final theme within the grey literature features four publications that discuss measurement and resilience. Two cover the theory and the operationalisation of measuring resilience (Gregorowski et al., 2017; Jeans et al., 2017), while the other two describe indicators for predicting crises in Organisation for Economic Co-operation and Development (OECD) countries (Hermansen and Rohn, 2017) and methods of assessing and valuing ecosystem services (Agardy et al., 2017).

*The evidence showed that the majority of indicators would have helped predict severe recessions in OECD economies and that indicators of global risks consistently outperform domestic indicators*

In their publication for Oxfam, Jeans et al. (2017) describe resilience capacity and what it looks like in practice, made up of three types of capacity: (1) absorptive capacity characterised by stability, (2) adaptive capacity characterised by flexibility, and (3) transformative capacity characterised by structural change. All three capacities are described as essential for resilience and, as well as being interconnected, they are mutually reinforcing and exist at multiple levels (individual, household, community, etc). They highlight that resilience capacity is strengthened by enhancing collaborative ways of working across levels, sectors and actors, and by engaging in and developing six social change processes including: informing, accountable governing; gender; justice and empowerment; forward, flexible planning; learning and innovation; and securing and enhancing livelihood.

Delving deeper into measuring resilience in practice, Gregorowski et al. (2017) draw on case study evidence and views of leading specialists to offer a discussion of key lessons and challenges in operationalising resilience measurement (i.e. monitoring, evaluation and learning, or MEL) frameworks. Some of the challenges identified in this report were associated with how to: (1) determine the frequency of measurement required to capture the dynamic nature of resilience; (2) combine household-, community- and system-level data; (3) understand and measure transformative capacity and system changes; (4) support field-level practitioners; and (5) share data with other actors in engaging formats.

The third publication in the measurement theme focuses on economic resilience and predicting severe recessions and crises in OECD countries (Hermansen and Rohn, 2017). A signalling approach is employed to evaluate the usefulness of predictive indicators, taking into account policy-makers' preferences between missing crises and inducing false alarms.[7] The evidence shows that the majority of indicators would have helped predict severe recessions in OECD economies and that indicators of global risks consistently outperform domestic indicators, highlighting the importance of considering international developments when assessing a country's vulnerabilities. At the domestic level, indicators that measure asset market imbalances and domestic credit were found to be particularly useful in signalling upcoming crises.

Drawing on a qualitative description of ecosystem services being provided by natural habitats, Agardy et al. (2017) lay the groundwork for a description of the factors affecting ecosystem services delivery. The report presents an assessment of ecosystem services of the North Ari Atoll in the Maldives conducted in 2015. This showed a number of ecosystem services being provided by the coastal and marine natural habitats, including fisheries, ecotourism, hazard mitigation, water quality maintenance and spiritual and cultural benefits. These benefits were quantified, with total profits from the different sectors associated with ecosystem services in the area estimated at around $28 million per year. The report also provides estimations of net values under different management scenarios, indicating that significantly improved reef management would lead to a 110% increase compared to 'business and usual'.

Bekaye waters his vegetables near the Niger River in Bamako. Photo credit: Dominic Chavez/World Bank, 2013. CC BY-NC-ND 2.0.

7 One of the most common early warning methodologies to indicate a vulnerable state of the economy is when specific indicators cross a specific threshold. The threshold is chosen so as to balance between the risk of missing vulnerable states and issuing false alarms.

# 4. Resilience in the academic literature

This section introduces academic literature on resilience from the first quarter of 2017. It comprises 28 publications that span five thematic areas:

1. agriculture and food security
2. conceptual approaches, indicators and measurements
3. culture, politics and power
4. health
5. policy, planning and governance for building resilience.

## 4.1. Agriculture and food security

Academic literature on agriculture and food security suggests:

- bottom-up innovation can help farmers increase their resilience to climate impacts
- agroecological resiliency is necessary, but not sufficient, for achieving the sustainability of farming systems; social vulnerability and adaptive capacity also need to be addressed to strengthen the disaster resilience of rural societies
- resilience building needs to consider contexts, taking specific shocks, livelihoods and adaptation strategies into account.

As with previous Scans, a range of papers included in this quarter's review highlight the potential of small-scale agricultural systems to mitigate climate change. Altieri and Nicholls (2017) discuss examples of the potential for both adaptation and mitigation in agriculture. They highlight that farmers have traditionally integrated diverse strategies to address climatic influences in wetland and dryland regions throughout the world. The paper implies that enhanced complexity and plant diversity in farming systems can strengthen yield stability and increase resilience. Local knowledge and diversity in agroecosystems, according to the authors, should therefore be at the centre of attention for future adaptation strategies. In addition, the paper emphasises the potential of traditional agriculture to reduce greenhouse gas emissions, for instance due to lower use of fertilisers or pesticides. However, the authors also caution that agroecological resilience is necessary, but not sufficient, to achieve sustainability of farming systems. Alongside this agroecological component, social vulnerability and adaptive capacity need to be addressed to strengthen the disaster resilience of rural societies.

Gil et al. (2017) review existing evidence about the relationship between integrated agricultural systems (IAS) and climate resilience. IAS describe a beneficial combination of at least two of the different components of agriculture: livestock, crops and/or forests. Results suggest that IAS can enhance climate resilience in most cases, but only a few studies in the sample show causal relationships. Most of the studies reviewed took farm outputs or their stability (e.g. yields, crop failure or variance in profits) as proxies for resilience. This provides important insight into the role of IAS for rural livelihoods, but impacts on other dimensions of resilience remain less clear. Only a small number of studies tracked resilience across variable climatic conditions over time. Among those that did, however, the association between IAS and resilience was particularly strong. More research is required to establish causal links and to better understand the mechanisms and trade-offs in this relationship.

Guan et al. (2017) analyse whether agricultural adaptation strategies can reduce negative climate change impacts in Africa's western Sahel region. The strategies they consider include delayed sowing, intensification, use of varieties with a longer vegetative stage, water harvesting and adoption of varieties of sorghum with higher temperature tolerance. Results indicate that most of the strategies considered do not really mitigate climate change impacts. The exception to this is the use of varieties with higher temperature resilience, which is beneficial in current and future time periods until 2060. Finally, the study confirms different trajectories of climate resilience in the Sahel: the central area appears to benefit more from adaptation options, while the western area mostly experiences negative climate impacts, despite relying on the same strategies.

Like Guan et al. (2017), Tambo and Wünscher (2017) set out to measure climate resilience and to assess the role of different strategies – in this case, farmer innovations – in strengthening resilience. The authors argue that this is important as resilience building is crucial for farm households likely to experience future climate shocks. Farmer innovation, in their research, refers to farmers' processes of adapting practices, products, techniques and technologies in local farming systems from the bottom up. Relying on a household resilience index and survey data collected in northern Ghana, the research finds that the level of climate resilience among farm households in the study area is generally very low. Farmers who innovate, however, are around 6% more resilient than those who do not. One approach to enhancing rural resilience, following Tambo and Wünscher (2017), is therefore to support farmer innovation through adequate policy.

Rockström et al. (2017) discuss implications for agriculture arising from increasing global changes more broadly. They argue that an agricultural transformation is required to accommodate environmental as well as social changes, including climatic shifts and rising populations. New thinking and practices are required to meet increasing human needs, to enhance sustainable, livelihood-centred development and to strengthen socioeconomic resilience. The authors suggest that sustainable intensification of agriculture (SIA) can contribute to this shift to increasing production while supporting ecological functions.

Drought in Haro Huba Kabele, Fantale Woreda, East Shoa Zone in Ethiopia © Ayene/ UNICEF Ethiopia, 2016. CC BY-NC-ND 2.0.

However, the authors also clarify that an 'overall increase in production does not mean that yields should increase everywhere or at any cost: the challenge is context and location specific' (Rockström et al., 2017: 9). One key challenge is water management on all scales, as this is crucial to agricultural production and to ecosystem services. Similarly, SIA requires changes in land-use planning and agricultural practices to ensure rising yields and sustainability of Earth systems at the same time. According to the authors, the following three components are crucial to SIA from a production perspective: (1) resource efficiency, (2) resilience-building practices based on ecosystem services and functions, and (3) integration of approaches across scales.

Finally, two articles that discuss agriculture and food security in this review are also closely linked with resilience concepts and measurements (Birhanu et al., 2017; Seekell et al., 2017). Seekell et al. (2017) underscore the need for establishing national-level indicators describing the resilience of food systems in order to take stock and compare globally, and thus understand what drives response and adaptation of the global food system to disruptions. The authors focus on different dimensions of resilience, including socioeconomic components, biophysical capacity and production diversity. The research finds that few countries show low or high values on all resilience dimensions. In sum, the 'analysis shows different countries, and in many cases different regions, are resilient (or lack resilience) in different ways' (Seekell et al., 2017: 6). This, the authors conclude, represents the diversity and complexity of the global food system.

Many different resilience frameworks exist at the international level, often promoted by researchers, government agencies or NGOs in their approaches to resilience building. However, Birhanu et al. (2017) argue that resilience building needs to be context specific, taking specific shocks, livelihoods and adaptation strategies into account. The authors use grounded theory to develop a context-specific conceptual approach to resilience building in the pastoralist communities of the Borana Zone in Ethiopia. Their multi-dimensional concept takes into account (1) underlying vulnerability factors (environment); (2) immediate causes and effects (wealth, livestock, social services and infrastructure); (3) enabling and supporting factors (social capital, community networks, governance, security and peace); and (4) outcomes and impacts (human capital and psychosocial well-being). According to Birhanu et al. (2017), this framework can inform interventions in this specific context to support building resilience to persistent droughts that have eroded the adaptive capacities of pastoralist communities.

## 4.2. Conceptual approaches, indicators and measurements

Academic literature on conceptual approaches, indicators and measurements suggests:

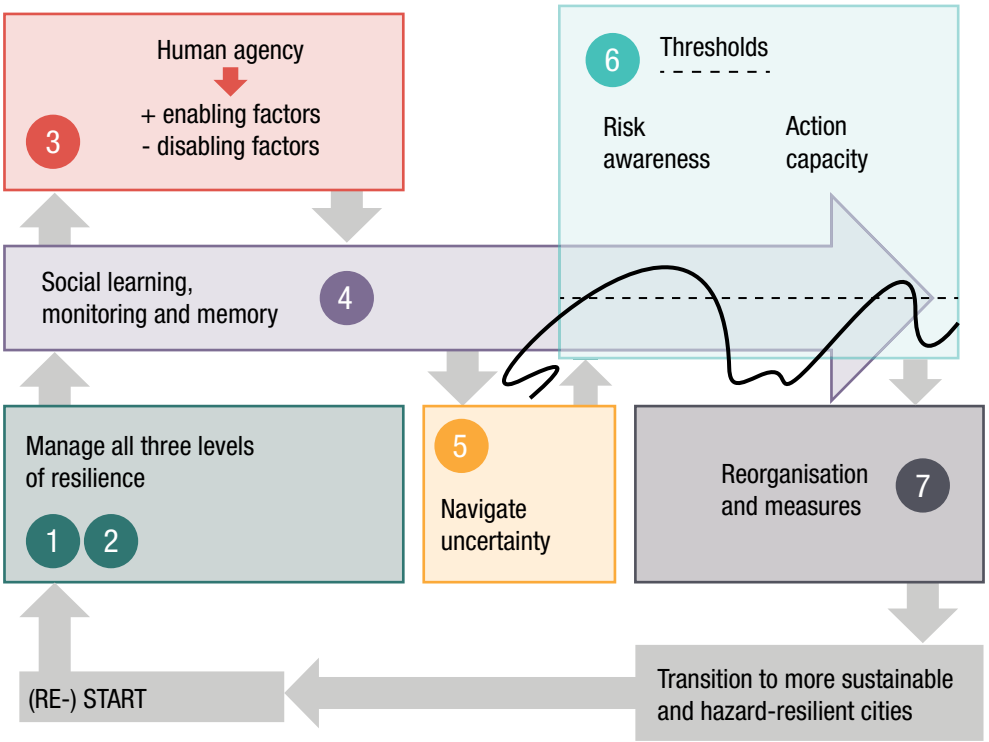
- deepening the integration of CCA, resilience and sustainability approaches and systems thinking can help decision-makers better prepare and deal with uncertainty
- sharing information and building trust, for instance within public–private partnerships (PPPs), enables greater resilience in supply chain networks
- in assessing the resilience of transitioning from a fossil-based to a renewable energy system, indicators that represent the diversity and connectivity of both technical and social system components are crucial.

Concepts, indicators and measurements represented a large focus area in this quarter's Scan, with six publications included under this heading and several others touching on it across the review, such as Dovie et al. (2017) and Watts et al. (2017) under health, or Seekell et al. (2017) and Birhanu et al. (2017) under agriculture.

Assessing resilience is a complex endeavour, and Keating et al. (2017) point out that few comprehensive approaches to measuring community resilience have been implemented and tested in practice to date. None of these approaches has verified sources of resilience by systematically connecting resilience characteristics before a disaster with outcomes after such an event has occurred. The Zurich Alliance, a collaboration of NGOs, the private sector and academia, proposes to reduce this gap with an innovative community resilience measurement tool. This tool draws extensively on different concepts from the theoretical literature on resilience – the sustainable livelihoods approach, the 4Rs (redundancy, rapidity, resourcefulness and robustness), systems thinking and disaster risk management principles – but is designed to be used easily by NGOs or other actors at the local level. The authors present a detailed description of the tool's development and implementation. This includes an overview of challenges encountered throughout the process, which can provide lessons for other policy-makers, researchers and practitioners aiming to understand what works for building disaster resilience.

Two articles in this review aim to contribute to a greater conceptual understanding of transitions in energy and water systems, respectively (Binder et al., 2017; Johannessen and Wamsler, 2017). Focusing on the transition from fossil-based energy to a renewable system, Binder et al. (2017) discuss the theoretical and conceptual grounds for the resilience of this transition process over time. They highlight diversity and connectivity as key components of resilience, both in technical and in social aspects required for the transition. The article introduces six indicators describing the resilience of energy systems: (1) variety, (2) disparity and (3) balance, which can all be used to measure diversity; and (4)

**Figure 23. Urban transitions towards sustainable and resilient cities**




*Source: Johannessen and Wamsler (2017)*

modularity, (5) degree centrality and (6) average path length suitable to measuring connectivity. Applying these indicators to different theoretical examples, the authors highlight the importance of considering all six simultaneously when assessing energy system resilience.

Johannessen and Wamsler (2017) argue that resilience concepts can inform thinking and practice around dynamic transitions in urban water systems. Drawing on a literature review, interviews and four case studies – Cebu (the Philippines), Durban (South Africa), Gorakhpur (India) and Kristianstad (Sweden) – they derive seven principles to be considered in this context: (1) three important resilience levels (socioeconomic, hazard and social-ecological), (2) integrated planning of these levels for resilience and sustainability, (3) focus on human agency, (3) social learning, (5) navigating uncertainty, (6) capacity for action and risk perception as thresholds for reorganisation and transition, and (7) supporting reorganisation (see Figure 23).

CCA and resilience have only recently started informing each other and breaking up their silos. Berbés-Blázquez et al. (2017) contribute to this engagement. The authors compile nine key resilience-building principles from existing literature: '(1) increasing diversity, (2) building redundancy, (3) enhancing connectivity, (4) managing slow variables, (5) managing feedbacks, (6) considering social-ecological interactions, (7) increasing participation, (8) providing opportunities for learning and experimentation, and (9) fostering polycentric governance' (Berbés-Blázquez et al., 2017: 230). They then go on to review the application of these resilience principles in a total of 224 CCA strategies used in 54 different projects funded by the International Development Research Centre (IDRC). Results reveal that most resilience principles are applied in about 20% to 30% of CCA strategies. Leaning and experimentation (principle 8) is present in more than half of all strategies, which, as the authors acknowledge, is related to IDRC's more general focus on knowledge and research. Social-ecological systems (principle 6) are least considered in CCA (slightly above 10%). The authors conclude that expanding on this integration and dedicating more attention to systems thinking in CCA is important to help decision-makers prepare better and deal with surprises.

Douxchamps et al. (2017) aim to facilitate the translation of resilience concepts into tools for application in the context of agricultural development and climate change. They identify 15 different resilience assessment tools from a comprehensive search, and review these in the article. These tools originated from NGOS, international organisations, research institutions and development organisations and can be broadly distinguished along the lines of the study characteristics, as well as the time requirements for implementing the assessment. The specific focus of each tool, unsurprisingly, is closely related to the underlying theoretical framework, approaches and practices of the organisation that developed it. The authors find valuable attempts that incorporate resilience dimensions into existing monitoring and evaluation tools by adding a resilience perspective to 'classical' development and sustainability approaches and by recycling indicators. However, it remains a key challenge to ensure the adequacy of simple and practical tools for capturing and addressing complexity.

Papadopoulos et al. (2017) use an innovative, data-driven approach to generate a theoretical framework for resilient post-disaster relief supply chains. The authors draw on a literature review and big (or unstructured) data from a range of sources, including Twitter, Facebook and YouTube, after the 2015 Nepal earthquake. They complement their analysis with survey (or structured) data, collected from over 200 disaster relief experts working in Nepal. The authors show the importance of public–private partnerships (PPPs), information sharing and swift trust for enabling resilience in supply chain networks. These critical enabling factors, the authors argue, can provide guidance to managers who aim at strengthening the resilience of supply chain networks in disaster recovery activities.

## 4.3. Culture, politics and power

Academic literature on culture, politics and power suggests:

- resilience thinking has facilitated a more nuanced discussion around climate-related migration, but has not completely replaced the previously dominant storylines that relate migration to conflict
- rehabilitation and reconstruction processes can co-produce new urban space and, over time, reshape indigenous forms of architecture
- sociopolitical structures and decisions can influence urban built environments and create vulnerabilities; decision support systems for risk management and urban planning need to recognise these processes to implement resilience policy.

Four articles in this quarter's Scan discuss culture, politics and power dimensions of resilience thinking and practice. Rothe (2017) critically investigates recent political tendencies to frame climate-induced migration as an adaptive strategy for enhancing community resilience. This new angle, the author argues, breaks with previous alarmist narratives that saw migration as a security threat and a contributor to conflict over scarce resources. From a review of publications and policy papers, Rothe finds that resilience thinking contributed to a more nuanced view of migration. However, it also reproduces 'gender myths' about women's role in resilience building. This is related to the view that women, particularly in the Global South, are victims because they are

especially vulnerable to climate change. At the same time, they are knowledgeable, can drive change and are therefore saviours of their families and communities. The author concludes that resilience thinking has not completely done away with conflict-focused storylines, which still prevail in the discussion. In addition, the notion of empowerment in resilience thinking differs from the feminist understanding of the term and, in discussions around migration, gender is often not used in a comprehensive way to encompass the vulnerability of groups other than women and girls.

Feola (2017) explores the linkages and potential tensions between cultural diversity, transformation and resilience among peasants in the Colombian Andes. The article focuses specifically on traditional informal institutions, such as labour arrangements or reciprocal work exchange, and how these adapt to climatic and economic disturbances. Results imply that many informal institutions in the study area of Las Cañas have changed over time. This change includes eroded social networks, an increasing preference for cash instead of in-kind payments and a turn towards subsistence agriculture, all resulting from economic pressures. Nevertheless, most informal institutions and their underlying ethos and natural models have persisted despite disturbances. This persistence has been influenced by selective outmigration, cultural transmission between generations and continuing resistance to marginalisation, expropriation and exploitation. Contrary to the migration and resilience narrative outlined by Rothe (2017), outmigration from Las Cañas was more a forced choice than a voluntary adaptive strategy.

Shinde (2017) discusses the 1961 flood in Pune, India, and the implications of physical and social reconstruction for how people have since understood and used space in the city. The author builds on the concepts of spatial practice (the regular ways in which social actors produce space), representation of space (the knowledge and ideologies of social actors that inform spatial practice) and representational space (the images and symbols that actors attribute to space) to assess resilience and architecture developed with indigenous knowledge and resources. Drawing on these concepts, Shinde argues that the rehabilitation and reconstruction process after the Pune floods co-produced a new space. This space was manifested in new types of housing, especially cooperative housing societies, which emerged as an important architectural model and shaped the city's urban growth. These new settlements, the author finds, constitute representational space and as such have been internalised and produced new forms of indigenous architecture over time.

*Sociopolitical structures ... can influence urban built environments and create vulnerabilities*

Also related to an urban context, Eakin et al. (2017) call for greater recognition of political and social processes in planning, where the aim is to enhance sustainability and resilience. They argue that sociopolitical structures and decisions shape action and behaviour and, in turn, can influence urban built environments and create vulnerabilities. Decision support systems for risk management and urban planning in cities need to recognise these processes in order to propose and implement appropriate policies. The authors argue that new approaches and tools are needed to capture diverse risk preferences and characteristics of different actors, as these are at the basis of decision-making. For this, the authors suggest building on social science techniques and sustainability science strategies, for instance mental models and geographic information systems, as these can shed light on different perceptions and factors that drive decision-making and implementation by key urban actors. This also allows for a better understanding of how these decisions change vulnerability outcomes in cities across space and time.

## 4.4. Health

Academic literature on health suggests:

- multi-stakeholder engagement is needed to integrate climate change and resilience indicators with health sector indicators in order to adequately assess climate resilience
- the development of new indicators across different areas, including (1) hazard-related impacts, (2) adaptation and resilience, (3) climate change mitigation, (4) economics and finance, and (5) political engagement, can help track progress on health and climate change.

Health and resilience emerged as a new topic in this quarter's Scan. While two articles (Dovie et al., 2017; Watts et al., 2017) discuss health in relation to climate change, Weinhardt et al. (2017) assess outcomes of broader interventions under health constraints, in this case HIV.

Dovie et al. (2017) point to the potential threat that climate change poses to routine health indicators and public health risk management. A conservative public health sector, along with the reluctance to renew indicators, contributes to this threat and has slowed the development and integration of climate-sensitive indicators. Attempting to overcome this, Dovie et al. (2017) explore new indicators to support resilience against climate-sensitive diseases, such as malaria or diarrhoea. The authors then go on to validate the relevance, impacts and sensitivity of their indicators in the context of a case study of Ghana's health sector. Findings suggest the need for multi-stakeholder engagement to integrate climate change and resilience indicators with health sector indicators, as the latter alone

*Most articles this quarter on policy, planning and governance for building resilience are set in an urban context*

'are not sufficiently adequate to establish resilience to climate change' (Dovie et al., 2017: 844).

Closely linked with the concepts, indicators and measurements theme in this Scan, Watts et al. (2017) introduce 'The Lancet Countdown: tracking progress on health and climate change'. This is a global research collaboration of practitioners and academics from multiple disciplines. The Lancet Countdown aims to track health across five areas: (1) hazard-related health impacts, (2) health adaptation and resilience, (3) co-benefits from climate change mitigation for health, (4) economics and finance, and (5) engagement across political and broader areas. To support this tracking and annual reporting ambition, the article discusses potential indicators, methodologies and datasets for the initiative. It also serves as a basis for further stakeholder engagement and an iterative and adaptive process of tracking health progress through the initiative. The authors view this as a complementary mechanism to other existing approaches, such as the WHO's climate and health country profiles or the Sendai Framework.

Weinhardt et al. (2017) assess the impact of broader development interventions on vulnerability to HIV and health outcomes. Specifically, the authors analyse impacts from an HIV intervention by CARE International in Malawi. The multi-stage intervention entails access to microfinance services through village savings and loan groups, as well as the promotion of crop diversification and sustainable agriculture for enhanced food security. Both components, in turn, potentially reinforce the reduction of vulnerability to HIV. The authors find that, over time, outcomes related to nutritional diversity, resilience to economic shocks and HIV testing significantly improved among the treatment group, implying a positive effect of the intervention. Nevertheless, not all results were consistently positive, highlighting the need for closer attention to remaining challenges, such as stunting and malnutrition. Furthermore, the authors underscore the importance of addressing structural contributors to HIV vulnerability, including access to testing and treatment. This article indicates how improving economic resilience to shocks can have positive implications for people's resilience to other types of hazard, including HIV.

## 4.5. Policy, planning and governance for building resilience

Academic literature on policy, planning and governance suggests:

- urban planners often consider resilience as a cost instead of as an opportunity to tackle uncertainty and facilitate investments in the sector
- the complexity of the resilience concept continuously presents a challenge for its practical implementation in urban planning – innovative tools and data sources (for instance, drawing on big data) can help to overcome this barrier
- urban resilience thinking and practice need to incorporate political considerations to avoid reinforcing existing challenges around social justice and the social construction of resilience
- people perceive and address climate change in different ways – combining climatic data with people's perceptions can therefore enhance the knowledge base on climate-related impacts and support climate-resilient communities.

Most articles in this quarter's Scan on policy, planning and governance for building resilience are set in an urban context. Juan-García et al. (2017), for instance, review existing literature on wastewater systems and how to assess and enhance their resilience. Overall, they find few papers and peer-reviewed articles on the subject of wastewater that also engage with resilience. The authors attribute this gap in research and implementation to the complexity of the resilience concept and to its diverse definitions. Furthermore, they highlight the lack of directly applicable, complete or comprehensive frameworks available to practitioners for assessing resilience. Related to these factors, the authors claim that resilience is regarded as a cost rather than opportunity to tackle uncertainty and facilitate investments in the sector. Understanding resilience across wastewater systems – in relation to a variety of stressors, properties, metrics and interventions – and developing effective tools and interventions are key to deepening the application of the resilience concept in this context.

Similar to Juan-García et al. (2017), Deal et al. (2017) point to the complexity of the resilience concept as a challenge to its incorporation into urban planning. To address this challenge, the authors argue, new planning support systems are required which can incorporate and translate big data and facilitate the flexible application of technology. Such systems need to provide approachable, useful, timely and effective support to planners to help communities become more resilient. In order to carry out these tasks, planning support systems should (1) be conscious of their own characteristics, users and

contexts; (2) be able to learn; (3) be capable of reasoning; (4) understand rules and help resolve conflicts; and (5) be easily accessible and interactive.

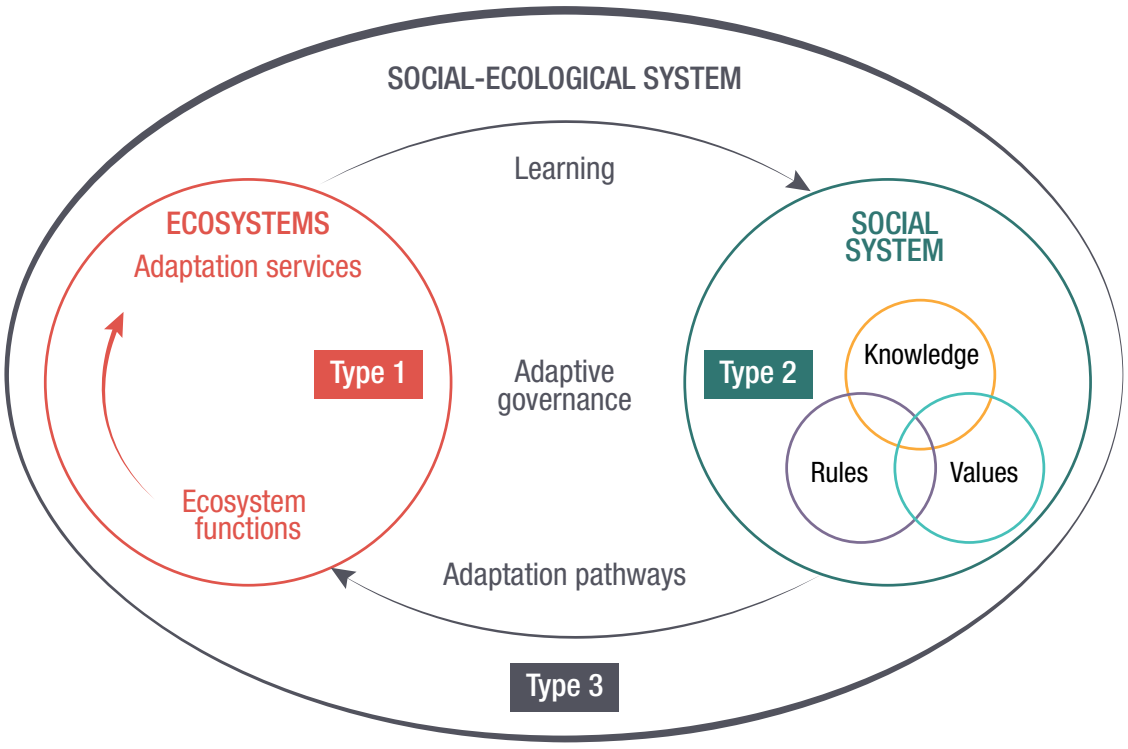
Colloff et al. (2017) introduce an integrated approach to transformative adaptation initially developed by the Transformative Adaptation Research Alliance (TARA). It builds on the concepts of values, rules and knowledge, adaptation services and adaptation pathways, and facilitates an understanding of the dynamics between social systems and ecosystems in the context of adaptation (see Figure 24).

The authors regard the TARA approach as a framework that can help deal with uncertainty and that takes into consideration agency and power in decision contexts. The article points out that this latter aspect has been somewhat neglected in resilience thinking, but is better accommodated in transformative adaptation approaches. Finally, the authors highlight the framework's potential to connect changing global ecosystems, decision contexts that accommodate societal change and transformative governance, all required to facilitate transformative adaptation.

Relating to the three previous articles in this thematic section, Béné et al. (2017) highlight the complexity and diversity across interpretations of urban resilience in existing studies. They assess the emergence of the resilience concept (see Figure 25) and its role as a policy narrative relating to urbanisation. Drawing on a systematic literature review, the authors highlight the increasing momentum that resilience has gained in literature that focuses on stresses and shocks in cities. The authors also point to a frequently criticised shortcoming in resilience thinking: it often fails to acknowledge the political economy of urbanisation. This means it may be used to increase the resilience of marginalised communities without challenging the political or economic status quo responsible for this marginalisation in the first place. In a policy and research context in which urbanisation is often presented in a positive light, urban resilience thinking thus risks reinforcing issues of social justice and the social construction of resilience.

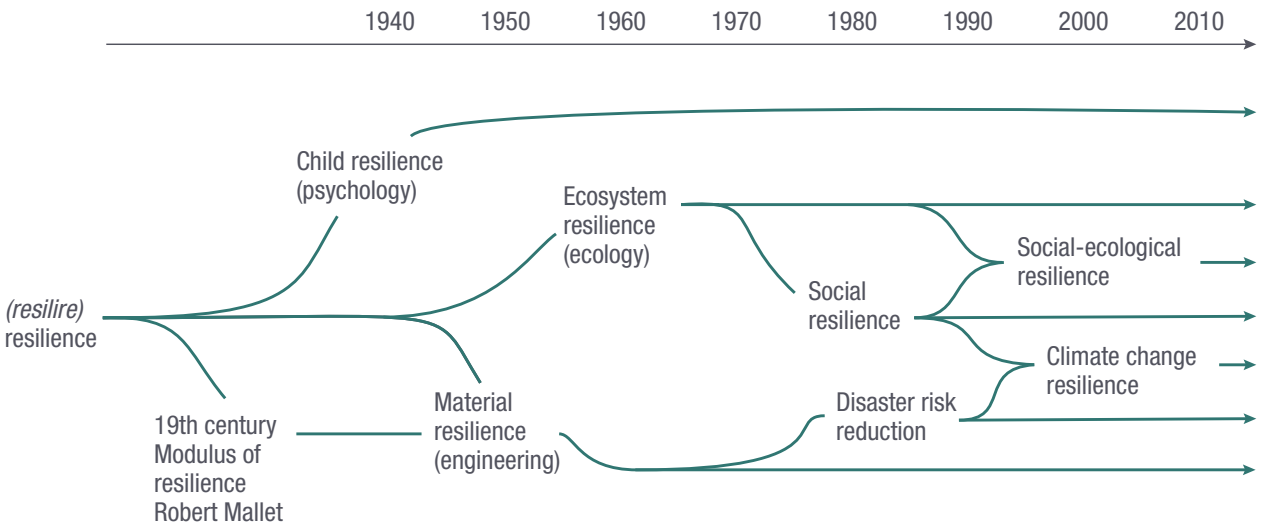
Two of the studies in this topic underscore the importance of capturing people's perceptions around the impacts of climate change or variability for enhancing policy-making that supports the resilience of communities (Devkota et al., 2017; Singh and Chudasama, 2017). Singh and Chudasama (2017) specifically call for a greater recognition of communities' perceptions, values, knowledge and adaptive behaviours around drought impacts in India's Mahabubnagar district. The authors use 'fuzzy cognitive mapping', which, among other advantages, is participatory in nature, is able to integrate data from diverse sources and allows for the modelling of complex systems. It thus relates well to concepts like resilience and uncertainty. Findings from the mapping and modelling exercise indicate the breadth of effects that farmers experience related to drought, in the worst case leading to vicious cycles of deteriorating well-being. Furthermore, results reveal the gender dynamics of drought impacts, with women being subject to different effects on their livelihoods than men, for instance by having to walk

**Figure 24. Transformative adaptation**




*Source: Colloff et al. (2017)*

**Figure 25. Evolution of the resilience concept over time**




*Source: Béné et al. (2017).*

longer distances to reach water sources. Diversification of agricultural practices and livelihoods, the study shows, are communities' key strategies of adaptation.

Devkota et al. (2017) assess climate change, disaster impacts and adaptation strategies through a perceptions-based approach in Nepal's Budhi Gandaki River Basin. Their results indicate that, though most respondents were aware of changing climate variability based on personal observations or media coverage, only 81% had perceived it. Findings also show that people experience climate change in the form of increasingly frequent extreme events, rising temperatures, as well as decreased and erratic rainfall. People reported economic instruments, such as incentives or financial tools, as the preferred option to address general climate change, while they reported technical measures, such as enhanced dykes, drainage or water reservoirs, as the most effective adaptation strategy against floods and droughts. The authors conclude that a combination of climatic data and people's perceptions can enhance the knowledge base on climate-related impacts and support climate-resilient communities.

As with last quarter's Scan, fishery governance is addressed within the policy, planning and governance theme. Cheung et al. (2017) model the distribution of different fish species that live across both exclusive economic zones and the high seas to assess implications of fishery governance for mitigating the impacts of climate change on seafood security. They conclude that cooperative management of fish stocks and, as a more extreme measure, the closure of high seas to fishing can increase the resilience of fish stocks in the medium term as compared to the current situation of no cooperation. A sustainable recovery of stocks through such governance approaches can make up for regional and global catch losses and diminishing stocks related to climate change. This, the authors imply, can also increase catches within exclusive economic zones, enhance equitable distribution of fish resources and strengthen coastal countries' economic resilience to climate change. Nevertheless, climate change impacts remain high, especially in very exposed regions that are highly dependent on fishing, such as the tropics. However, these findings are based on the assumption of sustainable management of stocks within exclusive economic zones. Yet, as the authors point out, this is not always the case in practice and local overfishing could undermine cooperative governance of high seas, which in itself is a highly ambitious endeavour.

Finally, Aka et al. (2017) present a snapshot of Cameroon's current state in the areas of disaster risk management (DRM), disaster preparedness and community resilience. This picture is based on 2013 data from the Views from the Frontline project under the Global Network of Civil Society Organisations for Disaster Reduction (GNDR). The authors conclude that, while there has been some progress in disaster prevention in certain areas of the country, Cameroon remains behind in global and regional comparison, and much remains to be done on national and local levels. Specifically, practical implementation and visible impacts from the numerous DRM laws seem to lag behind. The authors attribute this to a reactive and overcentralised approach to DRM. Based on this assessment, they discuss different policy options for boosting progress on DRM in Cameroon. As a way forward, they propose the foundation of a national agency to facilitate community-driven, development-oriented DRM and to disseminate targeted risk information.

# 5. Understanding the characteristics of resilience in 2017 Q1 literature

This section interprets the literature discussed in the grey and academic literature this quarter, based on five broad characteristics of resilient systems identified by The Rockefeller Foundation. These are distilled through a consideration of a wide body of research on this topic.

## 5.1. Awareness

Awareness is the ability to constantly assess, learn and take in new information on strengths, weaknesses and other factors through sensing, information gathering and robust feedback loops.

### Key messages

- Feedback loops and the reliable assessment of interventions and projects over time are important to ensure their success, and to help manage change and trade-offs effectively.
- Flexibility is core to building resilience, and this can often be achieved through bringing together a range of specialists and practitioners from different sectors to facilitate learning and innovation.
- Understanding people's dynamic preferences for certain adaptation strategies, and engaging communities in climate change and resilience policy discussions, is crucial for building community resilience.

The assessment of interventions and projects is a key theme within the grey literature, which reflects the need for information gathering and feedback loops. Rugege and Vermeulen (2017) assess an intervention to improve farmer access, quality, and utilisation of climate information services, alongside new climate resistant varieties of crops and forage. Mercy Corps (2017) assesses the effectiveness of a programme which aims to strengthen resilience in the Somali region of Ethiopia, while Agardy et al. (2017), in their study of Ari Atoll in the Maldives, call for enhanced methods to examine how the value of ecosystems services change over time. The authors recommend that future work should focus on the development of predictive models that can better represent and make sense of the trade-offs between conserving and enhancing natural habitats and ecosystems while yielding valuable ecosystem services and social well-being.

Jeans et al. (2017) recognise that change is ongoing and highly unpredictable, and therefore interventions require flexibility through a process of continual adjusting, learning and innovation. Simonet et al. (2017) examine 'economic resilience' over 42 years in 12 different BRACED countries in order to provide a risk typology which can be used to inform future resilience-building approaches. Meanwhile, Carabine and Simonet (2017) find that, while livestock and cotton producers generally understood the direct impacts of climate change on production and value chains, they had much lower awareness of how to adapt to these changes.

Several of the publications in the grey literature are reflective studies in which experts come together to produce guidelines or lessons for resilience-building initiatives. Gregorowski et al. (2017) combine experiences, lessons learned and knowledge from leading specialists and practitioners to help present ways in which resilience measurement, monitoring and evaluation can be improved. Similarly, the START Network (2017) brings together experts from a consortium of humanitarian, development, academic and peace-building institutions to produce a practical guide on building resilience in conflict-affected contexts.

There is a focus in the academic literature on integrating different sources and types of knowledge for enhanced decision-making and planning. Aka et al. (2017), Birhanu et al. (2017), Devkota et al. (2017) and Singh and Chudasama (2017) all highlight the importance of taking local contexts and existing knowledge, perceptions, values and capabilities into account when designing and applying frameworks aimed at building community resilience. Furthermore, understanding people's dynamic preferences for certain adaptation strategies and engaging communities in climate change and resilience policy discussions is crucial in this context. In an urban policy context, Béné et al. (2017) argue that urban planners need to be better aware of different interpretations of resilience if they want to use the concept appropriately and spell out what resilience can bring to their work.

## 5.2. Diversity

Diversity implies that a person or system has a surplus of capacity such that it can operate successfully under a diverse set of circumstances, beyond what is needed for everyday functioning or relying on only one element for a given purpose.

### Key messages

- In order to achieve buy-in and trust for resilience-building initiatives, a range of stakeholders at different scales need to be involved.
- The inherent diversity in traditional agricultural systems can help farming communities adapt to climate change.

Diversity within the grey literature is evident in two ways: livelihood and crop diversification (ActionAid, 2017), and engaging a diverse range of stakeholders to promote resilience (Tran, 2017). ActionAid (2017) presents a case study from Malawi and Senegal in which women are empowered to lead resilience-building initiatives, which include the diversification of crops and seeds. Meanwhile, Tran (2017) outlines lessons from the Asian Cities Climate Change Resilience Network (ACCCRN) programme, and highlights the fact that city resilience needs a diverse array of stakeholders and cannot be created by a single organisation.

In contrast with previous quarters, diversity is less of a focus in the academic literature in this Resilience Scan. Where articles do address diversity, this revolves around variety in resilience components or the different approaches to reducing vulnerability. Altieri and Nicholls (2017) point to the diversity in traditional agroecosystems as a strategy for enhancing CCA and mitigation. Seekell et al. (2017) find great diversity in the strength of various dimensions of food system resilience, including socioeconomic components, biophysical capacity and production diversity, between different countries. Finally, Weinhardt et al. (2017) point to some of the diverse mechanisms that may reduce vulnerability to HIV and, consequently, overall public health outcomes.

## 5.3. Self-regulation

This implies that a system can deal with anomalous situations and interferences without significant malfunction, collapse or cascading disruption. This is sometimes called 'islanding' or 'de-networking' – a kind of 'safe failure' that ensures any failure is discrete and contained.

### Key messages

- While greater connectivity is important, it is also necessary to ensure some autonomy so as to avoid over-reliance which could lead to cascading disruptions within a system.
- Resilience measurement tools in climate change and development often overlook systemic indicators related to transformation and self-regulation.

Three of the studies in the grey literature demonstrate characteristics of self-regulation. Lloyd's and Arup (2017) note that cascading impacts make assessing city risk extremely challenging as impacts cannot be predicted through traditional approaches, such as spatial risk. Carabine and Simonet (2017) highlight the disconnect between the producers of goods and the end market. The authors recognise the need to avoid over-reliance and to maintain adaptive capacity within the production system. FAO (2017b) highlights a mass vaccination campaign and control programme in Somalia, which has helped to reduce the repeated outbreak of sheep and goat plague (Peste des petits ruminants, or PPR) and has helped to restore the country's livestock trade.

A number of academic articles consider transitions and transformations of different systems as a pathway to greater resilience. This includes Douxchamps et al. (2017), who find that transformation, self-regulation and other systemic indicators (such as self-organisation) are the least considered aspects in resilience measurement tools in the field of agricultural development and climate change. Two of the key principles to support a transition to sustainable and resilient urban water systems, according to Johannessen and Wamsler (2017), are enabling factors and thresholds in adaptation capacity and risk awareness. The authors highlight the importance of internal adaptive processes that can drive transition towards more resilient systems in the right enabling context and under different thresholds, ranging from incremental changes to complete collapse and reorganisation.

Feola (2017) assesses resilience, transformation and cultural diversity in relation to informal traditional peasant institutions. He finds that such institutions managed to adjust and preserve their cultural diversity despite, or sometimes in response to, external pressures.

## 5.4. Integration

Being integrated means individuals, groups, organisations and other entities have the ability to bring together disparate thoughts and elements into cohesive solutions and actions. Again, this requires the presence of feedback loops.

### Key messages

Partnerships between different sectors and scales are important to ensure greater coordination and cohesive action to build resilience effectively.

- Promoting the inclusion of women within initiatives is essential for building resilience; cohesive action is required to enable women to engage in decision-making which affects their lives.
- Integrating different farming practices and agricultural systems, including crops, livestock and forests, in a mutually beneficial way can help farming households to build climate resilience.
- Increasing conceptual and practical integration between CCA, sustainability and resilience approaches is necessary to strengthen climate resilience.

Numerous studies in the grey literature consider the integration of different sectors to strengthen resilience. Critchley and Radstake (2017) highlight the landscape approach, which integrates multiple environmental, social and economic objectives to reconcile competing land-use and environmental goals alongside building climate resilience. FAO (2017a) highlights the need to integrate agriculture, nutrition and social protection to reduce the triple burden of malnutrition, undernutrition and obesity, coupled with rising levels of non-communicable diseases and micronutrient deficiencies.

Partnerships are also an important theme within the grey literature, and are highlighted at the community, national, regional and international levels. At the community level, 100 Resilient Cities (2017) promotes community engagement to build urban resilience, while recognising the role that technologies can have in terms of building social cohesion and a strong sense of community in the face of an uncertain future. Studies by WFP (2017) and GFDRR (2017) highlight integration at the regional level, in social policy in the MENA region and coordination capacity of Regional Economic Communities to support DRM, respectively. At a global scale, UNDP (2017) promotes the need for global coordination and response to tackle El Niño/La Niña. Two studies focus on the need to mainstream gender into initiatives to strengthen leadership, cohesive action and resilience (ActionAid, 2017; Chaplin et al., 2017).

Several academic articles touched upon the integration of different systems and agricultural practices as a key strategy for enhancing resilience. In their review of empirical studies, Gil et al. (2017) investigate the combination of different agricultural systems for climate resilience. Binder et al. (2017) emphasise the interconnectedness between social and technical systems to understanding the resilience of energy transitions. Similarly, different components of the resilience concept, including diversity and connectivity, need to be considered simultaneously in assessing the resilience of regional energy systems. Papadopoulos et al. (2017) highlight the links between different components of a disaster supply chain network that can facilitate its overall resilience. Building on trust and information sharing, PPPs can strengthen the resilience of critical infrastructure and supply chains.

Integration of diverse knowledge from different sources was also highlighted as a key component to building resilience. In developing a tool for the measurement of community flood resilience, the Zurich Alliance found it crucial to integrate views from academia, practitioners and risk engineers (Keating et al., 2017). At a conceptual level, Berbés-Blázquez et al. (2017) call for a better integration of CCA and resilience approaches to support climate-resilient development. Similarly, Eakin et al. (2017) argue that combining resilience and sustainability thinking allows for a greater recognition of sociopolitical sources of vulnerability in urban planning and resilience building. Related to this, Juan-García et al. (2017) discuss and review the incorporation of the resilience concept into the field of wastewater systems management. The integrated framework to transformative adaptation presented by Colloff et al. (2017) incorporates values, rules and knowledge, adaptation pathways and adaptation services. This framework takes both social and ecological components into account.

Integration was also a crucial characteristic in the academic literature on health and resilience. Watts et al. (2017) present a framework and suggest indicators that allow for greater integration of climate change aspects into assessing health progress. Similarly, Dovie et al. (2017) promote integration of health and climate change concepts and practices. Introducing ecological and social indicators to indicators for public health can strengthen the consideration of interdependent systems and contribute to building resilience in the health sector.

## 5.5. Adaptiveness

Adaptiveness is the capacity to adjust to changing circumstances during a disruption by developing new plans, taking new actions or modifying behaviours so you are better able to withstand and recover from the disruption, particularly when it is not possible or wise to go back to the way things were before. It also suggests flexibility and the ability to apply existing resources to new purposes, or for one element to take on multiple roles.

### Key messages

- 'No regret' and 'low regret' adaptation options provide good value, maximise co-benefits and ultimately build resilience.
- On-farm innovation and adaptation strategies can help mitigate impacts from climate change and variability, but the effectiveness of specific adaptation strategies depends on future climate developments.
- A renewal of urban planning systems is required to consider and embrace the complexity in resilience building. Planning support systems need to become increasingly interactive and adaptive to be more useful for urban planners in built environments.

Women cooperative supporting biodiversity and livelihoods in Katfoura, Guinea. Photo credit: Joe Saade/UN Women, 2016. CC BY-ND-NC-2.0.

Adaptation and adaptive capacity to help achieve resilient outcomes is highlighted in a number of publications in the grey literature. As underlined in the awareness section, Jeans et al. (2017) considers adaptive capacity as one of the three capacities needed to build resilience. Bugler and Palin (2017) provide a framework for effective adaptive governance, while CDKN (2017) describes the importance of prioritising 'no regret' and 'low regret' adaptation options, such as practising crop diversification or substitution to support climate-resilient investment in the Caribbean.

A range of academic studies in this review discuss the implications of current and future changing climates and challenges arising from global environmental change in the future. In this context, Rockström et al. (2017) suggest that a radical transformation is necessary to shift thinking towards agricultural practices that can both meet human needs and contribute to sustainability and socioeconomic resilience. At the farm level, Guan et al. (2017) consider agricultural adaptation strategies, finding that most do not reduce climate impacts significantly in the western Sahel region, whereas they are more beneficial in the central Sahel. Tambo and Wünscher (2017) show that farmers often use their own interventions instead of relying on externally driven technologies. Innovative farmers were found to be around 6% more climate resilient than others, implying the value of bottom-up approaches to innovation.

In an urban context, Shinde (2017) highlights the potential of post-flood reconstruction and recovery to adaptively reshape the construction and representation of urban space in Pune, India. Disasters and resilience are regarded as contributors to this process. Deal et al. (2017) argue for the need for a renewal of urban planning systems in order to consider and embrace complexity in resilience building. The authors emphasise the need for planning support systems to be interactive and adaptive so as to be more useful for urban planners in built environments. Finally, Rothe (2017) discusses the recent shift in how migration is portrayed: from a dominant image of security and conflict to seeing migration as an adaptive strategy in the broader context of resilience building. This shift, the author argues, also introduces a greater focus on women and their role as agents of change for building resilience.

# References

## References and further reading on self-recovery for resilience


Ashdown, P. et al. (2011) *Humanitarian emergency response review*. London: Humanitarian Emergency Response Review.

Bahadur, A.V., Peters, K., Wilkinson, E., Pichon, F., Gray, K. and Tanner, T. (2015) *The 3As: tracking resilience across BRACED*. London: BRACED Knowledge Manager.

Barakat, S. and Zyck, S.A. (2011) 'Housing reconstruction as socio-economic recovery and state building: evidence from southern Lebanon', Housing Studies 26(1): 133-154.

Bolin, R. and Stanford, L. (1991) 'Shelter, housing and recovery: a comparison of U.S disasters', *Disasters* 15(1): 24-34.

Choudhury, M.U. and Haque, C.E. (2016) '"We are more scared of the power elites than the floods": adaptive capacity and resilience of wetland communities to flash flood disasters in Bangladesh', *International Journal of Disaster Risk Reduction* 19: 145-158.

Curato, N. (forthcoming) 'From authoritarian enclave to deliberative space: governance logics in post-disaster reconstruction', *Disasters*.

Davis, I. (1978) *Shelter after disaster*. Oxford: Oxford Polytechnic Press.

Davis, I. and Alexander, D. (2016) *Recovery from Disaster*. Abingdon: Routledge.

Flinn, B. and Echegaray, M. (2016) *Stories of recovery: CARE Philippines post Haiyan/Yolanda shelter response*. London: CARE International UK.

Global Shelter Cluster (2016) 'Cash and markets in the shelter sector'. GSC Position Paper. Geneva: Global Shelter Cluster.

Graber, E., Pichon, F. and Carabine, E. (2015) *Psychological resilience: state of knowledge and future research agendas*. London: Overseas Development Institute

Jones, L. and Tanner, T. (2015) *Measuring 'subjective resilience': using people's perceptions to quantify their resilience*. London: Overseas Development Institute.

Kelman, I., Ashmore, J., Leon, E. and D'urzo, S. (2011) 'From research to practice (and vice versa) for post-disaster settlement and shelter', *Environmental Hazards* 10(3-4): 262-278.

Manyena, S.B., O'Brien, G., O'Keefe, P. and Rose, J. (2011) 'Disaster resilience: a bounce back or bounce forward ability?' *Local Environment* 16(5): 417-424.

Masud-All-Kamal, M. (2013) 'Livelihood coping and recovery from disaster: the case of coastal Bangladesh', *Journal of Social Sciences* 5(1): 35-44.

Maynard, V., Parker, E. and Twigg, J. (2017) *The effectiveness and efficiency of interventions supporting shelter self-recovery following humanitarian crises: an evidence synthesis*. Oxford: Oxfam GB.

Parrack, C., Flinn, B. and Passey, M. (2014) 'Getting the message across for safer self-recovery in post-disaster shelter', *Open House International* 39(3): 47-58.

Parrack, C., Brun, C., Jordan, Z. and Harriss, L. (forthcoming) *Building safety in post-disaster self-recovery: a review of current knowledge*. Oxford: Centre for Development and Emergency Practice.

Pelling, M. and Manuel-Navarrete, D. (2011) 'From resilience to transformation: the adaptive cycle in two Mexican urban centres', *Ecology and Society* 16(2): article 11.

Platt, S., Brown, D. and Hughes, M. (2016) 'Measuring resilience and recovery', *International Journal of Disaster Risk Reduction* 19: 447-460.

Salloum, A. and Lewis, M. (2010) 'An exploratory study of African American parent-child coping strategies post-Hurricane Katrina', Traumatology 16(1): 31-41.

Schilderman, T. and Parker, E. (eds) (2014) *Still standing? Looking back at reconstruction and disaster risk reduction in housing*. Rugby: Practical Action Publishing.

Schofield, H. and Miranda Morel, L. (2017) 'Whose recovery? Power, roles and ownership in humanitarian shelter assistance', *Humanitarian Exchange* 69: 29-30.

Tierney, K. and Oliver-Smith, A. (2012) 'Social dimensions of disaster recovery', *International Journal of Mass Emergencies and Disasters* 30(2): 123-146.

UNISDR (2015) Sendai Framework for Disaster Risk Reduction 2015-2030. Geneva: United Nations International Strategy for Disaster Reduction (www.preventionweb.net/files/43291_sendaiframeworkfordrren.pdf)

## Grey literature


100 Resilient Cities (2017) *100RC: Catalyzing the urban resilience market*. New York, NY: 100 Resilient Cities (http://action.100resilientcities.org/page/-/100rc/pdfs/100RC%20-%20Catalyzing%20the%20Urban%20Resilience%20Market.pdf).

ActionAid (2017) *Women's leadership in resilience: eight inspiring case studies from Africa and Asia*. Johannesburg: ActionAid International Secretariat (http://actionaid.org/sites/files/actionaid/2017_womens_leadership_in_resilience.pdf).

Agardy, T., Hicks, F., Nistharan, F., Fisam, A., Abdulla, A., Schmidt, A. and Grimsditch, G. (2017) *Ecosystem services assessment of North Ari Atoll Maldives*. Gland: IUCN. (https://portals.iucn.org/library/sites/library/files/documents/2017-003.pdf).

Bugler, W. and Palin, O. (2017) 'From the ground up: How communities can collaborate to drive local adaptation and influence the national agenda'. CDKN Briefing Paper. London: Climate and Development Knowledge Network (https://cdkn.org/resource/policy-brief-ground-communities-can-collaborate-drive-local-adaptation-influence-national-agenda/?loclang=en_gb).

Carabine, E. and Simonet, C. (2017) *Value chain analysis for resilience in drylands (VC-ARID): Identification of adaptation options in key sectors*. VC-ARID Step 1 Synthesis Report. London: Pathways to Resilience in Semi-arid Economies (http://prise.odi.org/wp-content/uploads/2017/03/VC-ARID-Step-1-Synthesis-Report_Low_Res.pdf)

CDKN (2017) 'Climate impacts on agriculture and tourism: the case for climate resilient investment in the Caribbean'. CDKN Policy Brief. London: Climate & Development Knowledge Network (https://cdkn.org/wp-content/uploads/2017/02/GIP01755_Caribbean_tourism_policy_brief_final_web-res.pdf).

Chaplin, D., Byekwaso, F., Semambo, M., Mujuni, G., Bantaze, J., Nyasimi, M. and Wabyona, E. (2017) *The impacts of climate change on food security and livelihoods in Karamoja*. Copenhagen: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) (https://cgspace.cgiar.org/handle/10568/80562)

Critchley, W., and Radstake, F. (2017) *Sustainable land management in Asia: introducing the landscape approach*. Mandaluyong City: Asian Development Bank (https://www.adb.org/sites/default/files/publication/224336/landscape-land-mgt.pdf).

FAO (2017a) *Regional overview of food security and nutrition in Africa 2016: The challenges of building resilience to shocks and stresses*. Accra: Food and Agriculture Organization of the United Nations (www.fao.org/3/a-i6813e.pdf).

FAO (2017b) *Strategic work of FAO to increase the resilience of livelihoods*. Rome: Food and Agriculture Organization of the United Nations, Strategic Programme to Increase the Resilience of Livelihoods to Threats and Crises (www.fao.org/3/a-i6463e.pdf).

GFDRR (2017) *Building disaster resilience in sub-Saharan Africa program: Result Area 2*. 2014-16 activity report. Brussels: World Bank Global Facility for Disaster Reduction and Recovery (https://www.gfdrr.org/sites/default/files/publication/ACP-EU%20Result%202%20%20AR_EN.pdf).

Gregorowski, R., Dorgan, A. and Hutchings, C. (2017) *Resilience measurement-MEL approaches in practice: challenges and lessons in operationalizing resilience measurement frameworks – experience and lessons from CoP stakeholders*. Hove: ITAD Ltd (www.measuringresilience.org/pdfs/ITAD_Report.pdf).

Hermansen, M. and Rohn, O. (2017) *Economic resilience: the usefulness of early warning indicators in OECD countries*. Paris: Organisation for Economic Co-operation and Development (www.oecd-ilibrary.org/economics/economic-resilience-the-usefulness-of-early-warning-indicators-in-oecd-countries_5jrxhgfqx3mv-en).

Lloyd's and Arup (2017) *Future cities: Building infrastructure resilience*. Emerging risk report 2017: society and security. London: Lloyd's of London and Arup (https://www.lloyds.com/news-and-insight/risk-insight/library/society-and-security/arup).

Mercy Corps (2017) *Enhancing resilience to severe drought: what works? Evidence from Mercy Corps PRIME program in the Somali region in Ethiopia*. Portland, OR: Mercy Corps (https://www.mercycorps.org/research-resources/enhancing-resilience-severe-drought-what-works).

Jeans, H., Castillo, G.E. and Thomas, S. (2017) *The future is a choice: absorb, adapt, transform resilience capacities*. Oxford: Oxfam International (http://policy-practice.oxfam.org.uk/publications/absorb-adapt-transform-resilience-capacities-620178).

Rugege, D. and Vermeulen, S. (2017) *Investing in on-farm and post harvest resilience to climate change in smallholder value chains: Lessons from Rwanda*. CCAFS Working Paper 193. Copenhagen: CGIAR Research Program on Climate Change, Agriculture and Food Security (www.indiaenvironmentportal.org.in/files/file/Investing%20in%20on-farm%20and%20post-harvest%20resilience.pdf).

Simonet, C., Comba, E. and Wilkinson, E. (2017) *Disasters and national economic resilience: an analysis of BRACED countries*. BRACED Working Paper. London: BRACED Knowledge Manager (https://www.odi.org/publications/10724-disasters-and-national-economic-resilience).

START Network (2017) *Integrated conflict prevention and resilience handbook*. London: START Network (http://programme.christianaid.org.uk/programme-policy-practice/sites/default/files/2017-03/Conflict%20Prevention%20Report%20.pdf).

Tran, P. (2017) *Building urban climate resilience: experiences from the Asian Cities Climate Change Resilience Network (ACCCRN) program in Viet Nam*. Hanoi: Institute for Social and Environmental Transition-International (http://i-s-e-t.org/resources/other/building-urban-climate-resilience-experiences-acccrn-viet-nam.html).

UNDP (2017) *UNDP's response to El Niño and La Niña: from recurring crisis to resilience. An investment case*. New York, NY: United Nations Development Programme (www.undp.org/content/undp/en/home/librarypage/climate-and-disaster-resilience-/undp_s-response-to-el-nino-and-la-nina--from-recurring-crisis-to.html).

Urban ARK (2017) 'Small disasters erode household resilience: the absorptive capacity of flood-prone households in Niamey, Niger'. Urban Africa Risk Knowledge Briefing (https://www.urbanark.org/sites/default/files/resources/UrbanArk_briefing_4_Niamey_English_FINAL%20web.pdf).

WFP (2017) *Middle East and North Africa initiative for school meals and social protection: a partnership for enhanced nutrition, education and resilience*. Cairo: World Food Programme (https://www.wfp.org/content/2017-mena-initiative-school-meals-and-social-protection-partnership-enhanced-nutrition-educa).

Women's Refugee Commission (2017) *Vulnerability- and resilience-based approaches in response to the Syrian crisis: implications for women, children and youth with disabilities*. New York, NY: Women's Refugee Commission (https://www.womensrefugeecommission.org/populations/disabilities/research-and-resources/1442-resilience-syrian-crisis).

## Academic literature

Aka, F.T., Buh, G.W., Fantong, W.Y., Zouh, I.T., Djomou, S.L.B., Ghogomu, R.T., Gibson, T., del Marmol, M.A, Sigha, L.N., Ohba, T., Kusakabe, M. and Yoshida, Y., Tanyileke, Nnange, J.M. and Hell, J.V. (2017) 'Disaster prevention, disaster preparedness and local community resilience within the context of disaster risk management in Cameroon', *Natural Hazards* 86(1): 57-88.

Altieri, M.A. and Nicholls, C.I. (2017) 'The adaptation and mitigation potential of traditional agriculture in a changing climate', *Climatic Change* 140(1): 33-45.

Béné, C., Mehta, L., McGranahan, G., Cannon, T., Gupte, J. and Tanner, T. (2017) 'Resilience as a policy narrative: potentials and limits in the context of urban planning', *Climate and Development*. https://doi.org/10.1080/17565529.2017.1301868. (Early View Articles Online Version of Record published before inclusion in an issue)

Berbés-Blázquez, M., Mitchell, C.L., Burch, S.L. and Wandel, J. (2017) 'Understanding climate change and resilience: assessing strengths and opportunities for adaptation in the Global South', *Climatic Change* 141(2): 227-241.

Binder, C.R., Mühlemeier, S. and Wyss, R. (2017) 'An indicator-based approach for analyzing the resilience of transitions for energy regions. Part I: theoretical and conceptual considerations', *Energies* 10(1): 36.

Birhanu, Z., Ambelu, A., Berhanu, N., Tesfaye, A. and Woldemichael, K. (2017) 'Understanding resilience dimensions and adaptive strategies to the impact of recurrent droughts in Borana Zone, Oromia Region, Ethiopia: a grounded theory approach', *International Journal of Environmental Research and Public Health* 14(2): 118.

Cheung, W.W., Jones, M.C., Lam, V.W., Miller, D.D., Ota, Y., Teh, L. and Sumaila, U.R. (2016) 'Transform high seas management to build climate resilience in marine seafood supply', *Fish and Fisheries* 18(2): 254-263

Colloff, M.J., Martín-López, B., Lavorel, S., Locatelli, B., Gorddard, R., Longaretti, P.Y., Walters, G., Van Kerkhoff, L., Wyborn, C., Coreau, A., Wise, R.M., Michael Dunlop, Degeorges, P., Grantham, H., Overtonq, I.C., D. Williams, R., Doherty, M.D., Capon, T., Sanderson, T., Murphy, H.T. (2017) 'An integrative research framework for enabling transformative adaptation', *Environmental Science & Policy* 68: 87-96.

Deal, B., Pan, H., Pallathucheril, V. and Fulton, G. (2017) 'Urban resilience and planning support systems: the need for sentience', *Journal of Urban Technology* 24(1): 29-45.

Devkota, R.P., Pandey, V.P., Bhattarai, U., Shrestha, H., Adhikari, S. and Dulal, K.N.( 2017) 'Climate change and adaptation strategies in Budhi Gandaki River Basin, Nepal: a perception-based analysis', *Climatic Change* 140(2): 195-208.

Douxchamps, S., Debevec, L., Giordano, M. and Barron, J. (2017) 'Monitoring and evaluation of climate resilience for agricultural development – a review of currently available tools', *World Development Perspectives* 5: 10-23.

Dovie, D.B., Dzodzomenyo, M. and Ogunseitan, O.A. (2017) 'Sensitivity of health sector indicators' response to climate change in Ghana', *Science of The Total Environment* 574: 837-846.

Eakin, H., Bojórquez-Tapia, L.A., Janssen, M.A., Georgescu, M., Manuel-Navarrete, D., Vivoni, E.R., Escalante, A.E., Baeza-Castro, A., Mazari-Hiriart, M. and Lerner, A.M. (2017) 'Opinion: urban resilience efforts must consider social and political forces', *Proceedings of the National Academy of Sciences* 114(2): 186-189.

Feola, G.( 2017) 'Adaptive institutions? Peasant institutions and natural models facing climatic and economic changes in the Colombian Andes', *Journal of Rural Studies* 49: 117-127.

Gil, J.D., Cohn, A.S., Duncan, J., Newton, P. and Vermeulen, S. (2017) 'The resilience of integrated agricultural systems to climate change', Wiley Interdisciplinary Reviews: *Climate Change*. https://doi.org/10.1002/wcc.461. (Early View Articles Online Version of Record published before inclusion in an issue)

Guan, K., Sultan, B., Biasutti, M., Baron, C. and Lobell, D.B. (2017) 'Assessing climate adaptation options and uncertainties for cereal systems in West Africa', *Agricultural and Forest Meteorology* 232: 291-305.

Johannessen, Å. and Wamsler, C.( 2017) 'What does resilience mean for urban water services?', *Ecology and Society* 22(1): article 1.

Juan-García, P., Butler, D., Comas, J., Darch, G., Sweetapple, C., Thornton, A. and Corominas, Ll. (2017) 'Resilience theory incorporated into urban wastewater systems management. State of the art', *Water Research*.

Keating, A., Campbell, K., Szoenyi, M., McQuistan, C., Nash, D. and Burer, M. (2017) 'Development and testing of a community flood resilience measurement tool', *Natural Hazards and Earth System Sciences* 17(1): 77-101.

Papadopoulos, T., Gunasekaran, A., Dubey, R., Altay, N., Childe, S.J. and Fosso-Wamba, S. (2017) 'The role of Big Data in explaining disaster resilience in supply chains for sustainability', *Journal of Cleaner Production* 142: 1108-1118.

Rockström, J., Williams, J., Daily, G., Noble, A., Matthews, N., Gordon, L., Wetterstrand, H., DeClerck, F., Shah, M., Steduto, P. and de Fraiture, C. (2017) 'Sustainable intensification of agriculture for human prosperity and global sustainability', *Ambio* 46(1): 4-17.

Rothe, D. (2017) 'Gendering resilience: myths and stereotypes in the discourse on climate-induced migration', *Global Policy* 8(S1): 40-47.

Seekell, D., Carr, J., Dell'Angelo, J., D'Odorico, P., Fader, M., Gephart, J., Kummu, M., Magliocca, N., Porkka, M., Puma, M., Ratajczak, Z., Rulli, M.C., Suweis, S. and Tavoni, A. (2017) 'Resilience in the global food system', *Environmental Research Letters* 12(2): 025010.

Shinde, K.A. (2017) 'Disruption, resilience, and vernacular heritage in an Indian city: Pune after the 1961 floods', *Urban Studies* 54(2): 382-398.

Singh, P.K. and Chudasama, H. (2017) 'Pathways for drought resilient livelihoods based on people's perception', *Climatic Change* 140(2): 179-193.

Tambo, J.A. and Wünscher, T. (2017) 'Enhancing resilience to climate shocks through farmer innovation: evidence from northern Ghana', *Regional Environmental Change* 17(5): 1505-1514.

Watts, N., Adger, W.N., Ayeb-Karlsson, S., Bai, Y., Byass, P., Campbell-Lendrum, D., Colbourn, T., Cox, P., Davies, M., Depledge, M. and Depoux, A., Dominguez-Salas, P., Drummond, P., Ekins, P., Flahault, A., Grace, D., Graham, H., Haines, A., Hamilton, I., Johnson, A., Kelman, I., Kovats, S., Liang, L., Lott, M., Lowe, R., Luo, Y., Mace, G., Maslin, M., Morrissey, K., Murray, K., Neville, T., Nilsson, M., Oreszczyn, T., Parthemore, C., Pencheon, D., Robinson, E., Schütte, S., Shumake-Guillemot, J., Vineis, P., Wilkinson, P., Wheeler, N., Xu, B., Yang, J., Yin, Y., Yu, C., Gong, P., Montgomery, H. and Costello, A. (2016) 'The Lancet countdown: tracking progress on health and climate change', *The Lancet* 389(10074): 1151-1164.

Weinhardt, L.S., Galvao, L.W., Yan, A.F., Stevens, P., Mwenyekonde, T.N.O., Ngui, E., Emer, L., Grande, K.M., Mkandawire-Valhmu, L. and Watkins, S.C. (2016) 'Mixed-method quasi-experimental study of outcomes of a large-scale multilevel economic and food security intervention on HIV vulnerability in rural Malawi', *AIDS and Behavior* 21(3): 712-723.

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