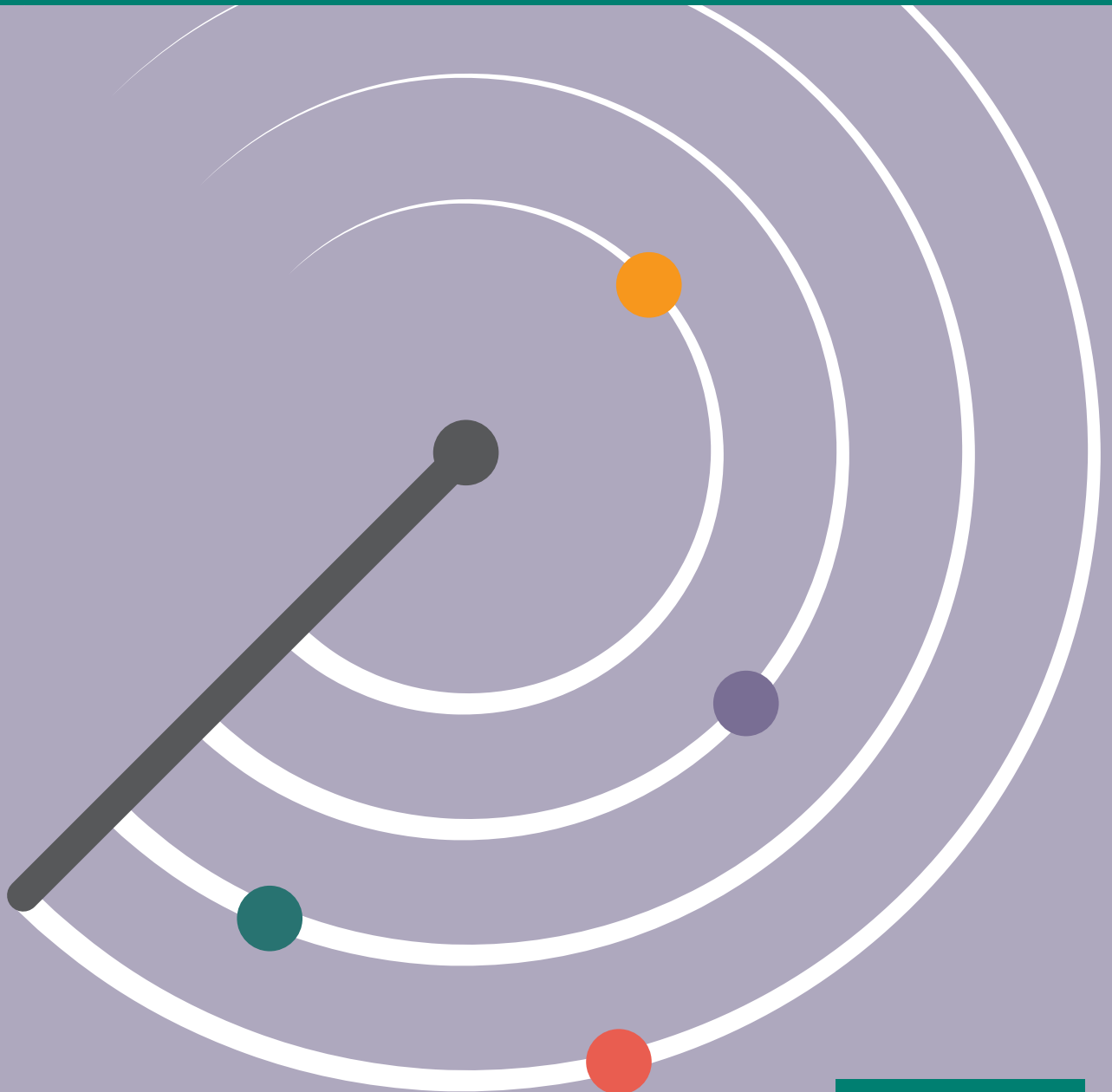# ODI

Resilience Scan | July–September 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.

odi.org/resilience-scan

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Acknowledgements

Acronyms

API	Application Programming Interface
BRACED	Building Resilience and Adaptation to Climate Extremes and Disasters
CDKN	Climate and Development Knowledge Network
CIAT	International Center for Tropical Agriculture
CORE	Coastal Community Resilience model
DRM	Disaster risk management
DRR	Disaster risk reduction
FAO	Food and Agriculture Organization
GHG	Greenhouse gas
GMSL	Global mean sea level
IDMC	Internal Displacement Monitoring Centre
IFPRI	International Food Policy Research Institute
IIED	International Institute for Environment and Development
IPCC	Intergovernmental Panel on Climate Change
ISET	Institute for Social and Environmental Transition
MENA	Middle East and North Africa region
NGO	Non-governmental organisation
ODI	Overseas Development Institute
RDVM	Resilience Dividend Valuation Model
RIA	Resilience Impact Assessment
RRA	Raising Risk Awareness
SFDRR	Sendai Framework on Disaster Risk Reduction
SIDS	Small Island Developing States
SLR	Sea-level rise
UHC	Universal health coverage
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UNISDR	United Nations International Strategy for Disaster Reduction

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Executive summary

Resilience: rising to the challenge in coastal regions

Coastal areas offer unique opportunities and challenges. The dynamics of the physical processes (from the daily tides to the ever-changing morphology) form the backdrop to some of the world's most productive and valuable habitats and give rise to distinctive coastal economies and cultures. But they are under extreme pressure as people, infrastructure, species and habitats (saltmarshes, coral reefs and mangroves) all vie for space, space that is being squeezed as land levels subside, sea levels rise and populations grow.

The challenge of resilience is therefore in sharp focus at the coast, but as yet no blueprint exists for what constitutes coastal resilience. This is not say there has been no progress. New approaches to the management of the coast are emerging, ones that adopt a whole-system approach to managing risk and set out adaptation pathways that recognise the interdependence between human systems and coastal ecosystems in building long-term resilience. Mainstreaming these approaches is, however, difficult, not least because of the uncertainty over long-term climate change mitigation policy (should we be planning to adapt to 1.5°C, 2°C or 5°C change in Global Mean Temperature?). Coastal adaptation will also require difficult trade-offs to be made and greater integration of action than hitherto (across spatial and economic planning, disaster risk management (DRM) and climate adaptation agendas).

This note summarises our understanding of the impacts of climate change at the coast and explores the challenges and opportunities presented. A greater emphasis on adaptation and resilience is promoted, including the need to make space for an increasingly squeezed coast to safeguard its natural dynamic resilience (and its role in supporting conventional engineered defences). Issues of regional sediment conflicts (as coastal areas are starved of sediments in response to development choices in the upstream catchment and updrift coast) and social injustice (as the vulnerable are disproportionately disadvantaged by climate change) are discussed as indicative of the multi-dimensional challenges at the coast and as underlining the need to mainstream whole-system, long-term thinking if we are to be successful.

Resilience on Twitter

This Scan provides an analysis of resilience conversations over two quarters, from April 2017 to September 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 below summarises the most prominent discussion themes and key influencers in debates and interactions.

Table 1. Resilience conversations and influencers on Twitter April–September 2017

Topic	Key conversations on Twitter	Top influencers on Twitter
Climate resilience	Ways to improve the resilience of the poorest and most vulnerable people to climate risk Ways to manage climate-related disaster risks (with emphasis on hurricanes) Using data for developing climate resilience strategies Climate resilience strategies in urban contexts The intersection of climate resilience, water and food security	**@WorldBank:** World Bank **@WBCaribbean:** World Bank Caribbean **@WBG_climate:** World Bank Climate **@CAREClimate:** CARE Climate Change and Resilience Platform **@dzarrilli:** Daniel A. Zarrilli, Senior Director, Climate Policy and Programs, Chief Resilience Officer @NYCMayor **@henkovink:** Special Envoy International Water Affairs, Sherpa High Level Panel on Water, Principal Rebuild by Design
Agriculture resilience	Innovations and technologies that help promote agriculture resilience, especially permaculture and solar energy Water shortages and their impact on agriculture resilience The promotion of smallholder farming knowledge, skills and management techniques as an important path to improving agriculture resilience The importance of biodiversity in strengthening agriculture resilience The intersection of food security and agriculture resilience	**@FAOKnowledge:** Food and Agriculture Organization (FAO) of the United Nations **@IFPRI_KM:** Research tweets from International Food Policy Research Institute **@WoodlandTrust:** The UK's largest woodland conservation charity **@agrifoodaid:** Cluster consortium that provides expert training across the agrifood supply chain in sub-Saharan Africa **@StepsCentre:** @ESRC Centre studying pathways to sustainability at @IDS_UK, @SPRU & worldwide
Food security resilience	The impact of droughts and water shortages on food security resilience The role of innovative farming techniques and food production technologies in mitigating food shortages Conflict and how it disrupts food security resilience Developing resilient food systems in disasters Indigenous farming practices to enhance food security resilience	**@CECHR_UoD:** Centre for Environmental Change and Human Resilience **@RichardMunang:** Africa Environmental Hero Laureate, @UNEP Programme Innovation Award Winner **@JenSheridan:** Sustainable food systems researcher @VEILmelb **@WFP:** World Food Programme **@FAOWestAfrica:** FAO in West Africa
Conflict resilience	Ways to enhance the resilience of communities vulnerable to conflict The impact of food and water shortages on conflict resilience Displacement and migration caused by weakened conflict resilience Humanitarian response and strengthening resilience in contexts of violence	**@CRbuildpeace:** Conciliation Resources is an independent international peace-building organisation **@IISD_Resilience:** #Sustdev policy research on climate adaptation, food security and environmental issues in conflict and peace-building **@katiepetersodi:** Katie Peters, Research Fellow, ODI **@unfoundation:** United Nations Foundation
Urban resilience	The impact of climate change on urban resilience The role of collaborative design and collective problem solving in building more resilient cities Spatial justice Ways to strengthen urban resilience against disasters and natural hazards Mainstreaming the concept of urban resilience	**@Berkmic:** Michael Berkowitz, President @100ResCities, @RockefellerFdn **@100Rescities:** 100 Resilient Cities – Project by @RockefellerFdn helps cities become more resilient to the shocks and stresses of the 21st century **@IAWHQ:** International Water Association **@RockefellerFDN:** The Rockefeller Foundation **@ICLEI_ResCities:** Resilient Cities is the leading global forum on urban resilience **@UrbanResilienc:** Urban Resilience – professional tools and innovative solutions for urban design, citizen engagement and community sustainability solutions
Water resilience	Strengthening water resilience of communities in flood and drought-prone areas Diversification of water sources to strengthen water resilience Clean water infrastructure in urban and rural contexts Impact of access to water for agriculture on food security Adaptation strategies to water scarcity	**@ClimateAdapt:** Climate Adapt, Climate adaptation, urbanisation, resilience, and transformation for a sustainable future **@wwatercouncil:** World Water Council **@WHO:** World Health Organization **@meganrowling:** Megan Rowling, journalist with Thomson Reuters Foundation. Editor of http://zilient.org **@GetZillient:** Global network developed by @RockefellerFdn, @TR_Foundation, @TR_Foundation: The Thomson Reuters Foundation
Economic resilience	Ways to improve disaster recovery by focusing on economic resilience strategies The role of the private sector in strengthening economic resilience Development aid and economic resilience	**@ArreyMcNtui:** Arrey E. Ntui, author of *Murdering poverty: how to fix aid* **@ASEAN:** Association of Southeast Asian Nations **@OECDdev:** Organisation for Economic Co-operation and Development **@WorldBank:** World Bank **@ADB_HQ:** Asian Development Bank

Resilience in the grey literature

Our examination of the grey literature on resilience published in July–September 2017 includes 28 articles from research and private-sector institutions, humanitarian and development agencies. These span seven broad themes: finance and investment for resilience; urban resilience; climate and risk information; hard and soft infrastructure; agriculture and food security; fragility, conflict and governance; and taking stock of resilience concepts and approaches.

Grey literature on *finance and investment for resilience* suggests that:

- insurance can contribute to all three 'dividends' of investing in building resilience (avoiding losses, unlocking economic potential and generating development co-benefits)
- working with local markets following a disaster can inject cash into the economy, improve access to finance, provide economic opportunities for affected people and protect local networks
- cash transfer programmes have short-term benefits for resilience-building, with cash-for-work programmes particularly benefiting the capacities of women.

Grey literature on *urban resilience* suggests that:

- local concerns such as pollution, health, safety or electricity access are important entry points for urban climate action
- low-tech, ecosystem-based resilience solutions that can be supported by local people are often well suited to developing-country cities as they are easier and cheaper to implement and maintain, and require less expert knowledge
- resettlement and relocation of disaster-affected or at-risk communities should be seen as a last resort, and decisions should be made with all stakeholders.

Grey literature relating to *climate and risk information* suggests that:

- radio 'listening groups' can help to disseminate accessible weather and climate forecasts to rural communities, but benefits are hindered by lack of understanding of how to apply this information, limited access to radio equipment and other factors
- the risk of populations being displaced by disasters is distributed highly unevenly across the Greater Horn of Africa, concentrated in countries with densely populated and flood-prone river basins
- migrants who are not well integrated into society, especially those who do not speak the local language, may be poorly informed about impending hazards

- complex climate science can, and must be, communicated simply, with careful consideration of the needs of the particular audience.

Grey literature relating to *infrastructure* suggests that:

- the World Bank has new guidance for the prioritisation of climate-resilient investments in road infrastructure
- wetlands are an important natural infrastructure that enhance resilience to water-related hazards, and wetland management should be embedded within disaster risk reduction (DRR) policies
- in designing climate-resilient water infrastructure, decision-makers should 'go beyond the project' to maximise co-benefits with other sectors and stakeholders.

Grey literature relating to *agriculture and food security* suggests that:

- case studies from Kenya and Cameroon indicate that farming communities are taking measures to adapt to changes in climate, and that this adaptation is gendered (e.g. men are more likely to seek work elsewhere)
- new evidence indicates that the adoption of climate-smart agricultural practices has positive outcomes for sustainable agriculture production
- assistance for building resilient food systems should invest in national policy institutions and create asset-building opportunities, alongside providing emergency support, to address both short- and long-term risks.

Grey literature relating to *fragility, conflict and governance* suggests that:

- working with institutional realities in the application of new governance approaches, an incremental and long-term process of convening actors and creating space for engagement between stakeholders is needed
- as many of the central issues for the prevention and sustaining peace agenda are addressed in the Sendai Framework for Disaster Risk Reduction (SFDRR), implementation of this disasters framework would help to reduce both disaster and conflict risks
- market subsidy strategies and market systems change can have resilience-building benefits in fragile and conflict affected states.

Grey literature that is taking stock on *resilience-building* suggests that:
- while resilience has come a long way conceptually and as an operational approach, many challenges remain
- key challenges include the multiple interpretations of resilience, navigating trade-offs between different groups and measuring resilience.

Resilience in the academic literature

The academic literature on resilience scanned from the third quarter of 2017 covers 28 publications that cover five thematic areas: agriculture, livelihoods and food security; conceptual approaches, indicators and measurement; understanding impacts, policy and governance; community resilience; and health.

Academic literature on *agriculture, livelihoods and food security* suggests that:

- a range of common features – including integration, participation, system-based modelling and spatial explicitness – represent a more holistic farm model for resilient agriculture
- local climate adaptation practices of subsistence fishing communities can diverge from what policy-makers or researchers suggest, and therefore require greater consideration in policy-making
- the decision to diversify crops is driven by diverse motivations, but concerns around their household consumption may be the most decisive factor for farmers
- land degradation is closely intertwined with climate change: it can challenge the climate resilience of agricultural systems and land users, which, in turn, may increase pressures on ecological systems, further spiralling degradation
- increasing resilience in the production of nutritious and sufficient food requires a holistic approach that works across scales and across ecological and social interventions.

Academic literature on *conceptual approaches, indicators and measurement* suggests that:

- rigorous impact evaluations are possible in data- and resource-constrained contexts of resilience interventions if they address the use of counterfactuals, internal validity, social interaction threats and matching techniques
- the causes of social-ecological system collapse may be diverse and can lead to different types of collapse
- subjective approaches to measuring resilience may improve the understanding of resilience drivers, lower the questionnaire-burden for respondents and support resilience comparisons across cultures.

Academic literature on understanding *impacts, policy and governance for resilience* suggests that:

- local knowledge needs to feed into national and sub-national policy frameworks and local preparedness plans to effectively support fishers' resilience
- though experiencing a disaster can increase one's level of preparedness, people with higher levels of formal education may be better prepared even in the absence of a disaster
- relationships between urban centres and their periphery, complex local agencies and the politicisation of local resources, such as opium poppy and timber, can play a reinforcing role at the intersection between climate change and conflict.

Academic literature on *community resilience* suggests that:

- the effectiveness of conventional project management approaches for supporting communities' longer-term disaster resilience in reconstruction is limited, because they do not take prevention or preparedness into account
- urban resilience policies can favour physical infrastructure development, but need to consider other components, such as sociopolitical relationships, values, norms and rules for reducing disaster risks and increasing resilience in informal settlements
- long-term outcomes from reconstruction projects were best when based on (1) an 'agile' project approach, (2) community trust, (3) a combination of technology, skilled labour and materials for hazard-safe housing, and (4) ongoing capacity-building within communities.

Academic literature on *health* suggests that:

- investment in climate change and health research, compared to other sectors such as agriculture, has been considerably lower
- droughts can have serious health impacts, but the difficulty of pinning down their exact starting point, and their creeping onset and silent continuation, mean that these effects are often not recognised or not attributed to droughts.

1. Resilience: rising to the challenge in coastal regions

1.1. Climate change: sea levels, coastal storms and shoreline response

The Global Mean Sea Level (GMSL) rose by around 20 centimetres between 1901 and 2010 (Rhein et al., 2013). The rate of sea-level rise (SLR) during the 20th century was faster than at any point since reaching near modern-day levels around 3,000 years ago (Kopp et al., 2016) and is currently increasing at around 3.2 millimetres per year (Chambers et al., 2017). Around 70% of this rise is attributable to human greenhouse gas (GHG) emissions (Slangen et al., 2016) that have increased global surface temperatures and in turn driven thermal expansion of the oceans (accounting for around 40% of the rise in GMSL) and increased the flow of water into the oceans from ice sheets and glaciers (Chambers et al., 2017). There is now a growing consensus that the rise in GMSL may reach 1 metre by the end of the 21st century. The Intergovernmental Panel on Climate Change (IPCC)'s Fifth Assessment Report suggests the upper limit of likely range of SLR will reach 0.98 m by 2100 (IPCC, 2013). If GHG emissions continue without mitigation, credible projections suggest it could rise by up to 2.5 m by 2100 (plausible 'extreme' upper-bound scenario (Sweet et al., 2017)) and many metres over longer timescales. There is, however, significant uncertainty in these projections, particularly over the future (in)stability of the ice sheets in Greenland and Antarctica (Nicholls et al., 2013). Substantial mass loss from these ice sheets would have significant consequences for global SLR. However, sea-level change is not uniform across the globe and, at a local scale, land subsidence (e.g. due to local land drainage or loss of sediment supply) and regional geological and meteorological processes (influencing gravitational effects and ocean circulations) act to drive relative SLR higher and lower in different locations, leading (in general) to rates of maximum rise at low-to-mid latitudes (e.g. Hu et al., 2011; Rovere et al., 2016).

Coastal lowlands are particularly vulnerable to climate change, yet these lowlands are densely populated (home to more than 600 million people) and this is set to grow dramatically (e.g. Lichter et al., 2011; Neumann et al., 2015). As a consequence, many coastal cities, particularly those in the low-lying coastal floodplains and deltas, are concentrations of risk (including, for example, the Rhine–Meuse–Scheldt delta in Europe, the Mississippi delta in North America, the Nile and Niger deltas in Africa, the Ganges-Brahmaputra delta in India, the Irrawaddy and Mekong deltas in Asia). If we fail to enhance our adaptation effort, the combination of projected socioeconomic and climate change could see global flood losses increase significantly to US$1 billion per year by the 2050s (an increase of more than a hundredfold compared to the situation today (Hallegatte et al., 2013)). Small Island Developing States are also highly vulnerable to climate change (e.g. Dye et al., 2017; Nunn and Kumar, 2017). Direct observational evidence of this vulnerability is also increasing. For example, although atolls and small island landforms are inherently dynamic, five vegetated reef atolls have been lost from the Solomon Islands between 1947 and 2014, a loss that has been attributed to rising sea levels and erosion (Albert et al., 2016).

Figure 1. The 20 cities with the highest relative coastal flood risk (i.e. the ratio of average annual losses to gross domestic product, GDP) (in 2005)
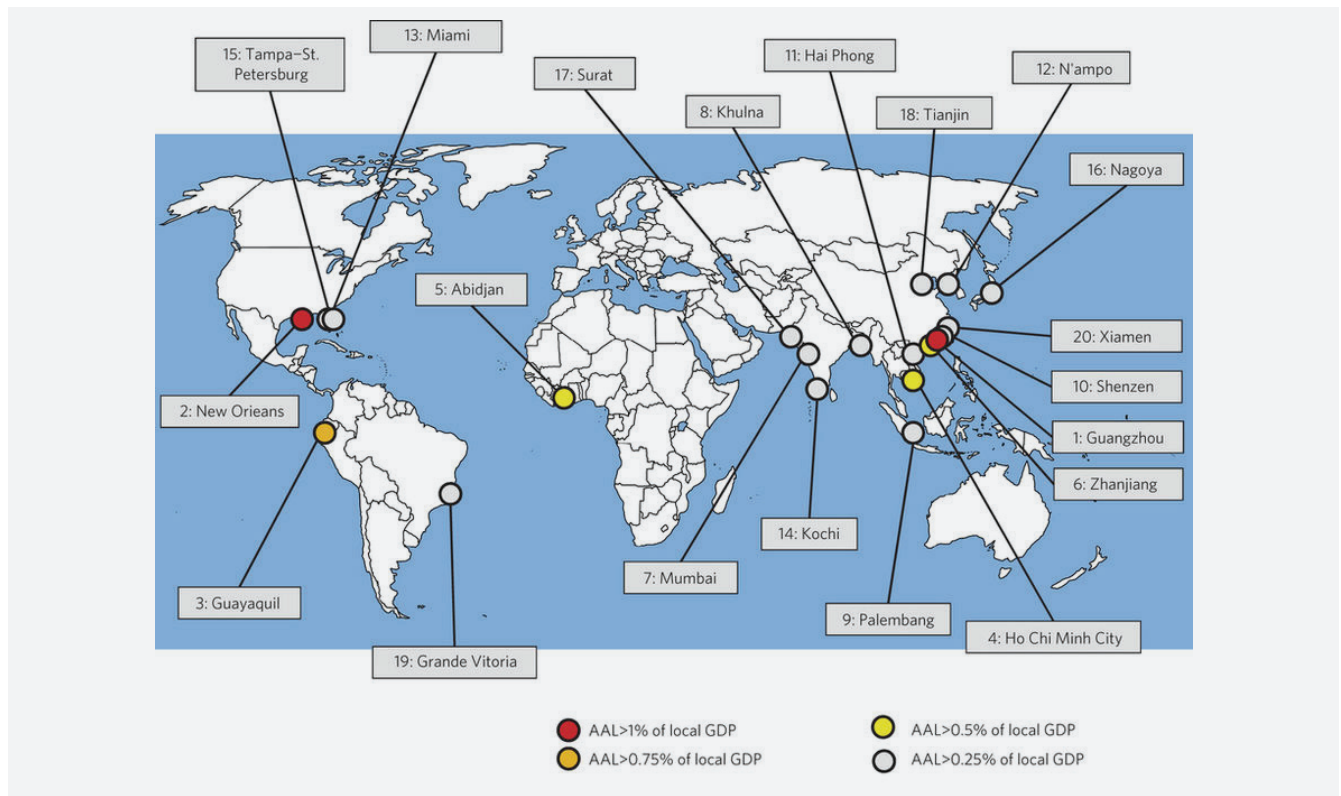
Source: Hallegate et al. (2013)

The 21st century has also provided a stark reminder of the devastating power of extreme coastal storms. There are many examples across the developing and developed world: from Hurricane Katrina in the United States in August 2005 (with an estimated 1,464 people losing their lives (Jonkman et al., 2009) and economic damages exceeding US$150 billion (Burton and Hicks, 2005)); to Cyclone Sidr (2007) and Cyclone Aila (2009) that hit Bangladesh (with eight million people exposed to inundation depths greater than 3 m resulting from cyclonic storm surges (Dasgupta et al., 2011)); to the recent destruction caused by successive Hurricanes Harvey, Irma and Maria along much of the Caribbean islands of Barbuda, Saint Martin, Anguilla, Dominica, the British and US Virgin Islands and Puerto Rico (and others), which also carried extreme rainfalls to the coastal areas of the US mainland.

Climate change impacts the severity of these storms in well understood and more subtle ways. Many coastal defences are exposed to depth-limited wave conditions. In the absence of SLR, this implies that nearshore wave heights will stay the same despite a change in offshore wave conditions. SLR acts to increase nearshore water depths and, in doing so, larger waves are able to reach to the coastline, even if the offshore conditions remain unchanged. Although each coastline will respond differently, Dawson et al. (2009) demonstrated that long-term changes in coastal flood and erosion risk in north Norfolk in England were significantly more sensitive to SLR, due to the reduction in the depth-limitation of wave conditions, than changes in

growth of offshore wave heights and changes in direction. There is also some evidence that hurricanes and coastal storms will become more severe (e.g. IPCC, 2012), and the impact of such a change is clear. Even less well understood is the impact of increased clustering of storms. As the 2017 hurricane season comes to a close, the multiple hurricanes (including Harvey, Irma, Maria and Jose) experienced by the Gulf Coast and the Caribbean highlight the devastating impacts of multiple storms. These storms impacted some areas repeatedly; in the Caribbean, for example, Puerto Rico and the Dominican Republic were hit by several severe storms, while Louisiana and other Gulf Coast states faced multiple landfalls in August and September (e.g. CNN, 2017; ABC News, 2017). But even clusters of much more moderate storms can undermine the natural resilience of the coast. The natural dynamics of the coast allow it to respond to a storm event and then recover before the following storm. This process can be disrupted by storm sequences. In these circumstances coastal erosion can be considerable, even when the severity of the individual storms is small (Figure 2). This highlights the need to consider event sequences as well as single design storms (or hurricane scenarios) in building resilience at the coast. The concept of a single design storm is increasingly recognised as not fit for purpose (Sayers et al., 2015a) and, given the context of climate and socioeconomic change, we can no longer plan for the future based on historic records and analogues alone (e.g. Milly et al., 2008).

Figure 2. The effects of storm clustering on beach profile variability

Beach erosion volume against storm power for single storms

(a)

Erosion volume (m³/m): 0, 40, 80, 120, 160, 200
Storm power (m²hr): 0, 2000, 4000, 6000, 8000, 10000

Beach erosion volume against storm power for storm clusters

(b)

Erosion volume (m³/m): 0, 40, 80, 120, 160, 200
Storm power (m²hr): 0, 2000, 4000, 6000, 8000, 10000

◆ Measured erosion volume   - - - - linear trend line
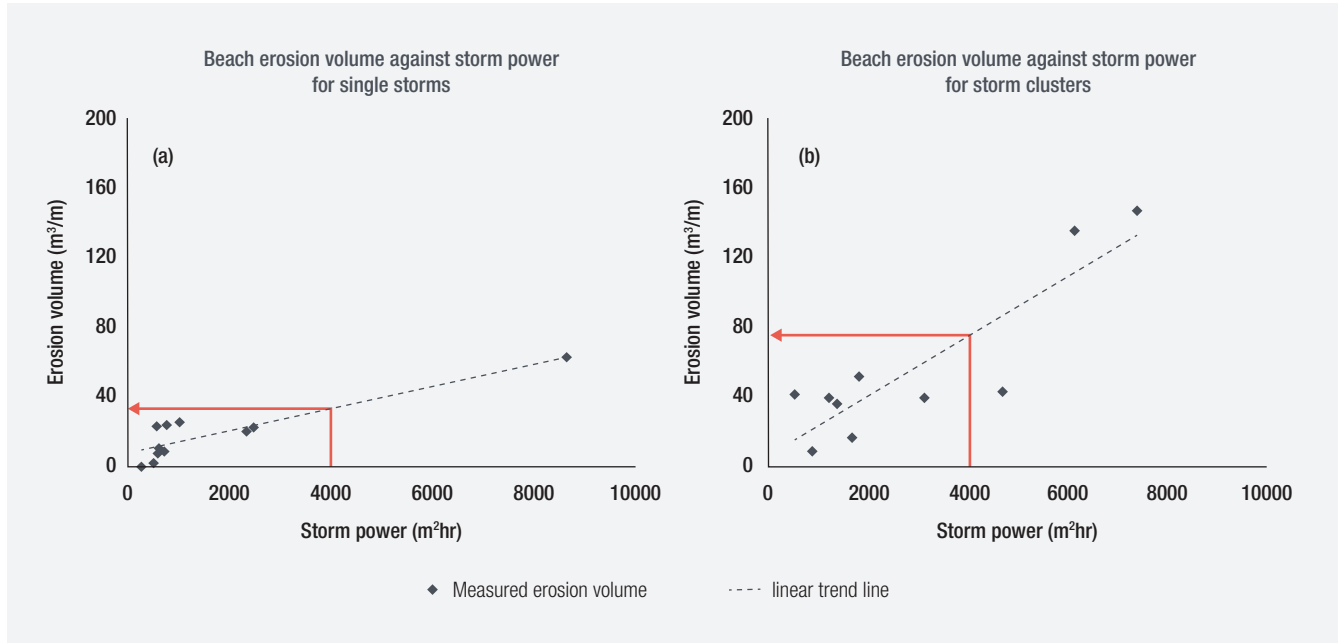
Source: Karunarathna et al. (2014)

1.2. Coastal resilience: the need for innovation and adaptation

If we are to respond successfully to the challenge of climate change and climate extremes, a step change in our approach is once again needed. One that combines DRM with longer-term adaptation planning, supported by effective climate change mitigation actions. Delivering this in practice will, however, present many challenges, and some opportunities, as highlighted below.

1.2.1. Managing the competition for space in a squeezed coastal strip

An unconstrained coast will naturally adapt to changing sea levels; retreating as they rise, advancing as they decline. Few coasts are afforded this opportunity today. Squeezed between rising sea levels and landward development, there is often little room for the mangrove forests, coastal dunes and wetlands to adapt and continue to afford this nature-based protection. Once constrained, a cycle of negative feedback starts. As a coastal habitat degrades, wave attenuation weakens, its ability to trap sediment reduces and foreshores lower and steepen. Any backshore defence is soon undermined and may require significant investment to hold a given shoreline position (Figure 3). Avoiding this downward spiral will require better longer-term planning that gives room to coasts to adapt.

Figure 3. Gambia: the beach is squeezed between development and the sea, unable to retreat, the beach lowers and protection is lost

Image: Katherine Kennedy

1.2.2. Managing the whole coastal system and the associated sediment flows

Coasts are dynamic, and their resilience relies upon maintaining this dynamism. Increasingly, controlled and developed upstream catchments and updrift coastlines act to restrict the sediment supply to delta and beach systems and limit their ability to provide protection against coastal storms (as experienced, for example, in the Mississippi, Nile, Ganges and Mekong deltas, e.g. Allison et al., 2017). In many instances, the management of these very large-scale sediment systems is fundamental to the resilience of the coasts at a local scale. Transnational conflicts that arise over the management of wild fish stocks to water resources are well documented, but 'sediment conflicts' between updrift and downdrift coasts and upstream catchment and downstream deltas are likely to emerge (in Myanmar and Bangladesh, for example).

1.2.3. Maintain the natural functioning of the coast and its natural resilience

Ecosystem-based approaches and the role of ecosystems in DRR and climate adaptation are well acknowledged and central to the concepts of resilience (e.g. Sayers, 2017). The IPCC Special Report (IPCC, 2012) reinforces this message in stressing the value of investing in ecosystems as part of climate change adaptation strategies, and ecosystem-based adaptation has been formally endorsed by the Subsidiary Body for Scientific and Technological Advice, under the auspices of the Nairobi Work Programme of the United Nations Framework Convention on Climate Change (UNFCCC, 2017). Decision-makers from the public and private sector are also beginning to explicitly consider the contribution that 'green' infrastructure (from mangrove forest restoration and preservation of barrier islands to the management of coastal dunes) can provide to coastal areas. Governments from the US to Australia now require the evaluation of, and are investing in, green infrastructure approaches for protecting communities and built infrastructure (Ruckelshaus et al., 2016).

Despite the international recognition of the importance of ecosystems, there continues to be limited progress in utilising ecosystem-based approaches in long-term DRR (by maintaining and extending coastal wetlands, dunes, mangrove forests to work in association with highly selective backshore structures). In part, this is because of our continued lack of scientific and practical understanding of ecosystems performance (in the short term when exposed to extreme storms and in the longer term in response to climate change and development pressure). A lack of political will to make difficult trade-offs between social and economic development while continuing to provide ecosystems with the necessary space, water quality and sediment connectivity can also act to constrain

progress. The challenge is therefore to mainstream these concepts into spatial planning (in a way that gives 'room to the coast' and is based on an understanding of present-day and future risks) and development designs (accounting for extreme storms and using a portfolio of conventional and ecosystem-based responses to build resilience at multiple spatial scales). At the moment, good theory does not routinely deliver good practice.

1.2.4. Ensuring a socially just approach to managing coastal climate risks

Social justice is promoted through international policy agendas, and it is accepted that climate change is a driver of global inequality and injustice (e.g. Black, 2016). An analysis of 'justice' is essential to our ability to understand the dynamics of geopolitics, mitigation actions and the associated trade-offs (Klinsky et al., 2017). At a national and more local level, social justice is an important consideration for orienting adaptation efforts (Sayers et al., 2017) and two justice issues are central to considerations as we attempt to adapt our coastlines to be more resilient:

- **Equity:** It is well documented that those who benefit from economic growth and associated GHG emissions are not necessarily those most vulnerable to change (e.g. IPCC, 2014: 6 notes that *'people who are socially, economically, culturally, politically, institutionally or otherwise marginalised are especially vulnerable to climate change'*). In coastal communities, the poorest are often the most exposed to coastal flooding and the influences of SLR; from poor coastal communities in Bangladesh, the 9th ward in New Orleans, US and across the UK where the most vulnerable communities are disproportionally exposed to coastal flooding (Sayers et al., 2017). Developing political solutions that address these inequalities presents a significant challenge, given the prevalence of utilitarian national policies (e.g. standard benefit cost analyses that do not incorporate equity), but will be central to promoting greater human health and well-being in the longer term.

- **Procedural justice:** Much of the coast is already constrained by past decisions and many of those at risk today have had little involvement in those decisions. As a result, the most vulnerable often have the quietest voice in the development plans and those with the loudest voice are often prioritised over those with the greatest need. Improving the procedural justice within the decision-making processes (i.e. ensuring those that may be affected by a decision are meaningfully engaged in shaping the choices made and the associated allocation of resources). Addressing this imbalance will be a central consideration as we choose how to adapt.

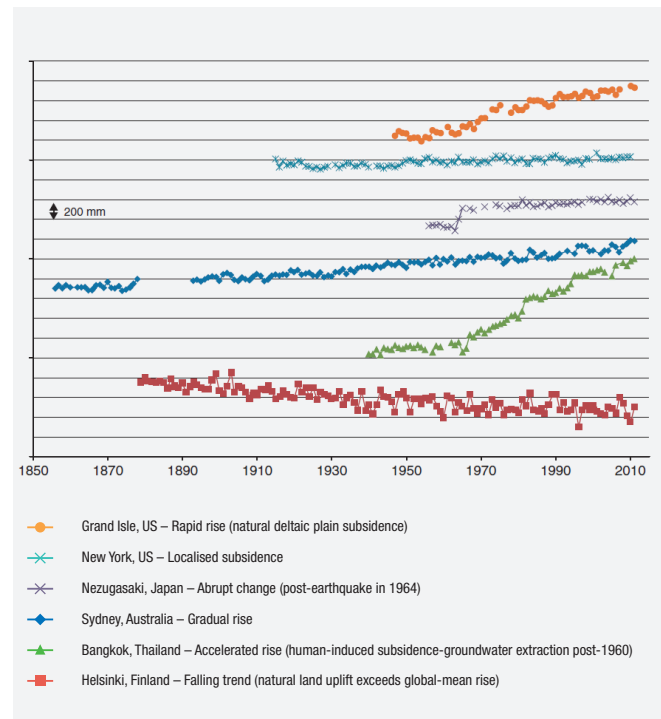## 1.2.5. Developing long-term coastal adaptation pathways

At the coast, the uncertainties in climate projections are particularly problematic for planning large-scale, long-lived and costly-to-reverse projects, such as public infrastructure and urban developments. Recognising the future as deeply uncertain does not, however, prevent decisions being made, but does demand a move away from conventional linear models of strategy development that are based upon a more certain view of the future, towards approaches that can adapt to an unknown future and seek to embed adaptive capacity within the choices made (e.g. Sayers et al., 2014).

In response, decision-oriented approaches are increasingly framed within a 'pathways' metaphor. Such framing emphasises the process of change and intertemporal complexity in transitioning from one approach to another and recognises the interactions between sectoral adaptation plans, vested interests and situations where values, interests or institutions constrain societal responses (Wise et al., 2014). Despite the maturing nature of this 'adaptation framing' there remain few examples of radically different 'transformative' adaptation, with the majority of adaptations largely incremental (but nonetheless important) adjustments to existing practices (e.g. providing better protection to critical services, raising awareness and developing evacuation plans/shelters (Lumbroso et al., 2017)). In low-lying coastal areas with significant relative SLR, assuming incremental change in current policies and management approaches, seeking to 'hold-the-line' will, in many locations, become increasingly costly and lead to significant loss of habitat (Figure 4).

The influence of SLR on coastal defences, and the cost of maintaining those defences, was recently explored in detail as part of the UK Climate Change Risk Assessment (Sayers et al., 2015b). The analysis suggests that just 50 cm of relative SLR will, in the absence of significantly increased investment, make 200 kilometres of coastal flood defences in England (20% of total length of present-day coastal defence) highly vulnerable to failure (Figure 5).

By linking the shorter term to the longer term, 'adaptation pathways' provide a framework for developing the multi-actor action that will be required to address the complex trade-offs that will inevitably exist at coasts as sea levels rise. In many coastal cities, the number of people and assets at risk is extremely high (e.g. Hallegatte et al., 2013) and relocation of the city and associated infrastructures to allow realignment of the coastline is difficult. The management of risk in these areas will depend on the success of global climate mitigation efforts, the ability to maintain regional sediment pathways and healthy ecosystems that work together with innovative engineered structures (where necessary) to provide the necessary protection. Where the opportunity exists to

Figure 4. Contrasting relative sea-level observations over the 19th/20th/early 21st centuries

- Grand Isle, US – Rapid rise (natural deltaic plain subsidence)
- New York, US – Localised subsidence
- Nezugasaki, Japan – Abrupt change (post-earthquake in 1964)
- Sydney, Australia – Gradual rise
- Bangkok, Thailand – Accelerated rise (human-induced subsidence-groundwater extraction post-1960)
- Helsinki, Finland – Falling trend (natural land uplift exceeds global-mean rise)

Note: The offsets between records are display purposes.
Source: Nicholls et al., 2013.

Figure 5. The length of present-day coastal flood defences in England that may become highly vulnerable to failure as mean sea levels rise
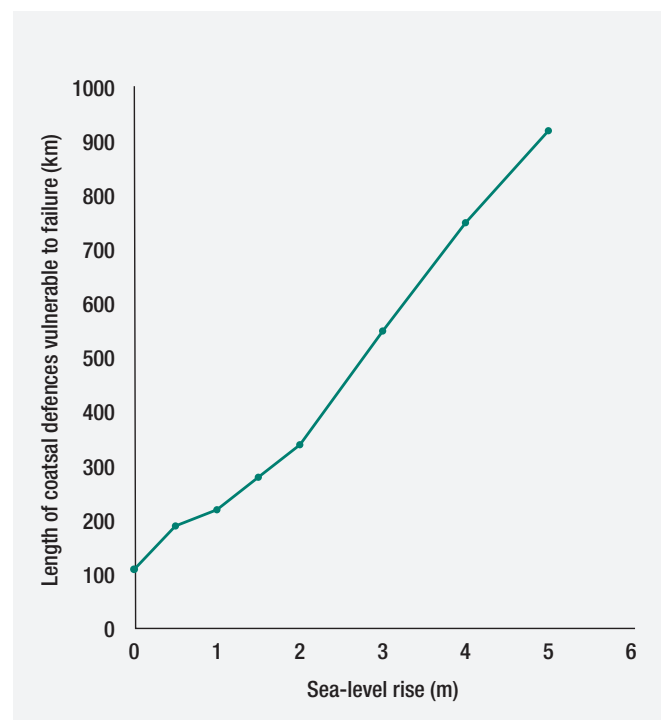
Source: Sayers et al., 2015b

realign the coast, good spatial planning will be central in maintaining this future option and ensuring space for the coast and transiting from the cycle of 'build and protect' to 'plan and adapt' (e.g. Esteves and Williams, 2017; Brown et al., 2017).

In this process of adaptation, storm events provide opportunity as well as risk. Investments are often most significant in the aftermath of storms (in delivering humanitarian aid and speeding the recovery process). Decisions made in the necessary reconstruction of infrastructure can either act to embed past vulnerabilities and foreclose future choices or reduce vulnerability to future storms. There are many examples of decisions made that run counter to providing longer-term adaptation (e.g. developments behind informal levees and hard engineering that attempt to stabilise coastal dunes and undermine their natural resilience). Understanding how to respond to emergencies while transitioning towards a more sustainable and resilient future is a significant challenge, but one we must get right if we are to avoid reinforcing past vulnerabilities.

1.3. So, what next?

It is now widely accepted that the present state of sea-level science provides unambiguous evidence that the sea level is rising and that the increase will continue to accelerate with unmitigated emissions (Stammer et al., 2017). Without urgent and significant action, the world will be committed to several metres of SLR in the next few centuries, with dramatically increased risks and significant management costs. We can meet this challenge and continue to enjoy the coast and the multi-benefits it provides. To do so, however, will require the broadest range of stakeholders to actively collaborate to address GHG emissions and develop innovative adaptations – making space of the coast where possible, safeguarding natural infrastructures and embedding resilience.

2. Resilience on Twitter: insights on influencers, networks and topics from April to September 2017

2.1. Methods: 'listening in' on Twitter

Short-form social media platforms like Twitter offer opportunities to tune in to 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.

Seven datasets comprising Twitter conversations about or specifically relevant to resilience in the context of seven sectors (climate, agriculture, food security, conflict, urban, water, economic) were created using an Application Programming Interface (API).[1] The datasets are analysed in two ways: content analysis (to explore thematic structures) and social network analysis (to map conversational and influence networks).

This section provides an analytical snapshot of:

- key influencers in Twitter conversations on resilience
- popular topics in Twitter conversations, and how the various sectors relate to each other in these conversations
- network clusters of resilience conversations on Twitter;[2] most importantly, who is driving the conversations, and who is talking to whom.

While a Twitter network analysis offers a useful snapshot of prominent themes in the period during which the data was collected, the thematic overlap across several sectors (e.g. the agriculture, food security and water sectors) can make it difficult to have an objective measure of comparative thematic prominence. Also, 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). These events, and the extent to which they influence resilience networks and conversations on Twitter, are highlighted in the analysis where identifiable.

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1 An API is a way for various software applications to access platforms like Twitter, thus enabling the acquisition of large datasets for research purposes.

2 The network maps are presented in simplified format from the raw datasets, with labels given for only the Twitter handles with central influence in the time period during which the datasets were acquired.

2.2. Climate resilience

Figure 6. Climate resilience word cloud

Conversations on climate resilience focus on:
- ways to improve the resilience of the poorest and most vulnerable people to climate risk
- ways to manage climate-related disaster risks (with emphasis on hurricanes)
- using data for developing climate resilience strategies
- climate resilience strategies in urban contexts
- the intersection of climate resilience, water and food security.

2.2.1. What has changed since the last Scan?

As with the previous Scan, the climate resilience Twitter networks exhibit significant overlap with the water, food security and resilience sectors. There are notable spikes in conversations on improving resilience in hurricane-prone areas, as well as more conversations on the intersection of climate resilience and water shortages. This is reflected in the network maps, which feature more participation from experts and organisations in the water resilience sector. There was a stronger regional focus during this period on the Caribbean.

Climate resilience network maps still feature a rather dense core of connected users. This sector enjoys the largest

Figure 7. Influence map of conversations on climate resilience
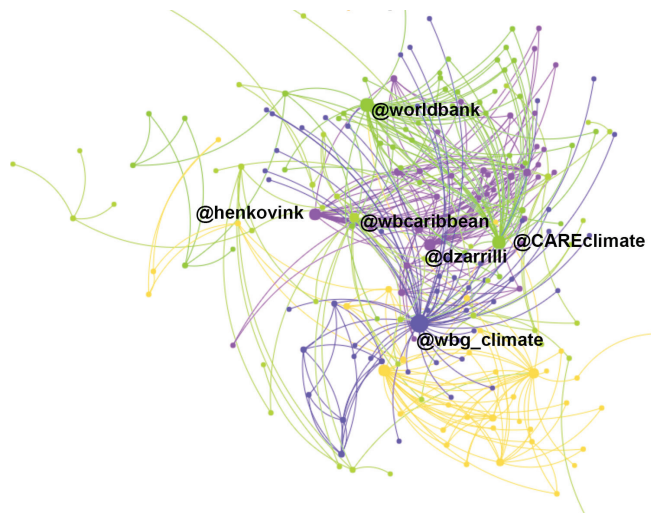
share of conversational prominence, as well as far-reaching relevance to the other six sectors, as shown by the larger number of clusters, or conversational communities, in the climate resilience network map (Figure 7).

2.2.2. Top influencers on climate resilience:
- @WorldBank: World Bank
- @WBCaribbean: World Bank Caribbean
- @WBG_climate: World Bank Climate
- @CAREClimate: CARE Climate Change and Resilience Platform
- @dzarrilli: Daniel A. Zarrilli, Senior Director, Climate Policy and Programs, Chief Resilience Officer @NYCMayor
- @henkovink: Special Envoy International Water Affairs, Sherpa High Level Panel on Water, Principal Rebuild by Design

Figure 8. Sample tweets

Down To Earth
@down2earthindia

#Crop diversification is one of the central pillars of climate resilience, writes economist Aziz Elbehri **goo.gl/6onbBm @FAOnews**

UNDP Climate
@UNDPClimate

Getting climate information and early warnings across the last mile key for **#ClimateResilience #Malawi**. @UNDPAfrica ow.ly/SZXF30d98GQ

Two million people will benefit from a new GCF-funded climate information project in Malawi.

UNA-USA San Diego
@UNASanDiego

Caribbean unveils **#climate** resilience plan at **#disaster** risk reduction conference **htl.li/FDxC30bkL5Z #tradition #technology**

Caribbean Rolls Out Plans to Reduce Climate Change Haza...
Climate change remains inextricably linked to the challenges of disaster risk reduction (DRR). And according to the head of the United Nations Office for Disaster Risk Reduction (UNISDR), ...
ipsnews.net

2.3.   Agriculture resilience

Figure 9. Agriculture resilience word cloud
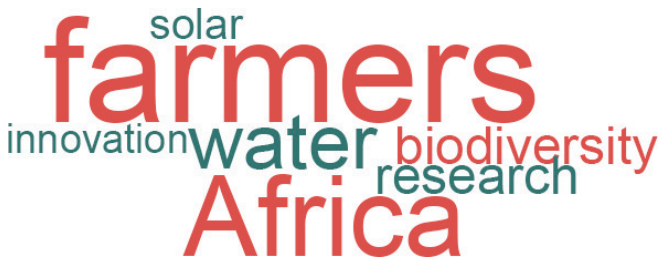
Conversations on agriculture resilience focus on:

- innovations and technologies that help promote agriculture resilience, especially permaculture and solar energy
- water shortages and their impact on agriculture resilience
- the promotion of smallholder farming knowledge, skills and management techniques as an important path to improving agriculture resilience
- the importance of biodiversity in strengthening agriculture resilience
- the intersection of food security and agriculture resilience.

2.3.1.   What has changed since the last Scan?

Agriculture resilience has a larger share of conversational visibility in this Scan. The African regional context claims the largest conversational attention.

Figure 10. Influence map of conversations on climate resilience
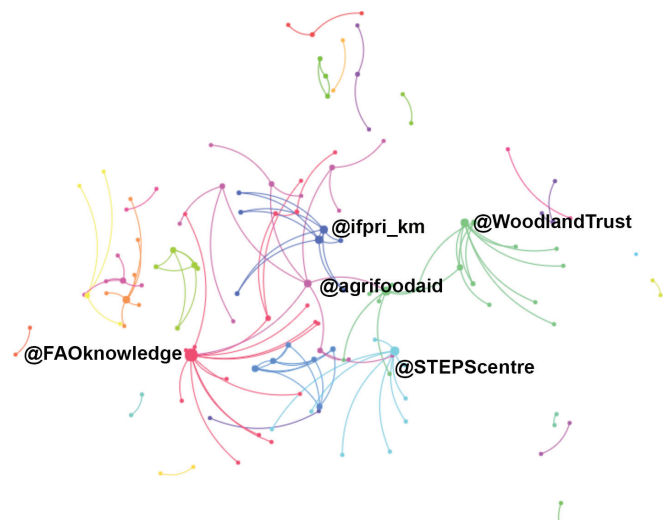
The agriculture resilience network maps are denser and less fragmented compared to the previous Scan. There is also a relative increase in the thematic relevance of agriculture resilience (Figure 10).

2.3.2.   Top influencers on agriculture resilience:

- @FAOKnowledge: Food and Agriculture Organization of the United Nations
- @IFPRI_KM: Research tweets from the International Food Policy Research Institute
- @WoodlandTrust: The UK's largest woodland conservation charity
- @agrifoodaid: Cluster consortium that provides expert training across the agrifood supply chain in sub-Saharan Africa
- @STEPScentre: @ESRC Centre studying pathways to sustainability at @IDS_UK, @SPRU and worldwide.

Figure 11. Sample tweets

AgriFoodAID
@agrifoodaid

#Resilience: A boost to knowledge and income of **#SmallFarmers**. Bit.ly/2mzm4kx #foodsecurity #agriculture #Education

Chris Henderson
@Chris_P_Hen

rural resilience needs support for more climate-resilient sustainable agriculture and irrigation **actionaid.org/publications/w…**

Empower Women
@Empower_Women

This is how to build resilience and social wellbeing for **#women** & **#girls** across **#agriculture**. **#EmpowerWomen bit.ly/2v9jGll**

2.4. Food security resilience

Figure 12. Food security word cloud

Conversations on food security resilience focus on:

- the impact of droughts and water shortages on food security resilience
- the role of innovative farming techniques and food production technologies in mitigating food shortages
- conflict and how it disrupts food security resilience
- developing resilient food systems in disasters
- indigenous farming practices to enhance food security resilience.

2.4.1. What has changed since the last Scan?

As with previous Scans, food security resilience is perhaps the sector with the most overlap with other resilience sectors, most importantly climate, agriculture and water resilience. The conversational focus is most notable around food systems for disasters, shocks and stresses, farming technologies, and also indigenous farming for strengthening food security resilience.

Food security resilience networks continue to be comparatively sparse, with conversational clusters fewer in number and further apart, and with little connection across communities (Figure 13). This can be attributed more to

Figure 13. Influence map of conversations on food security
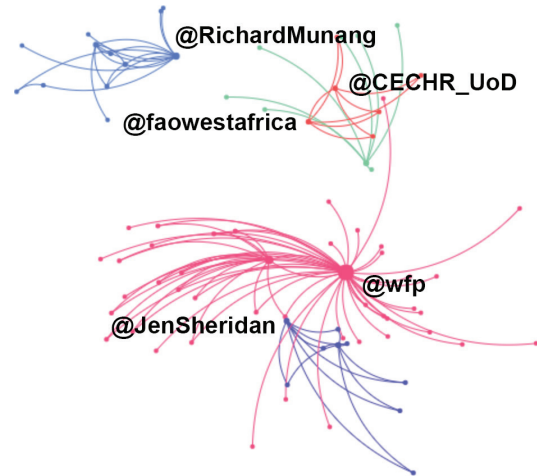
attempting to isolate conversations thematically around food security than a lack of Twitter conversational spheres on the sector. Again, due to the large thematic overlaps in the datasets, these snapshots are not always very accurate representations of the actual thematic significance, but rather are useful to understand how these conversations shift over time, and who influences them the most.

2.4.2. Top influencers on food security resilience:

- @CECHR_UoD: Centre for Environmental Change and Human Resilience
- @RichardMunang: Africa Environmental Hero Laureate, @UNEP Programme Innovation Award Winner
- @JenSheridan: Sustainable food systems researcher @VEILmelb
- @WFP: World Food Programme
- @FAOWestAfrica: FAO in West Africa.

Figure 14. Sample tweets

IUCN NL
@IUCNNL

Empowering civil society to safeguard **#watersecurity**, **#food** security and **#climate** resilience in the **#Chaco #Pantanal**

UICN América del Sur @UICN_SUR
"Recursos compartidos,soluciones conjuntas".Iniciativa de @IUCNNL para #Pantanal #Chaco en #Bolivia 🇧🇴 y #Paraguay 🇵🇾 goo.gl/NWkUcD

Mitidaption
@Mitidaption

Food security dependent on climate resilient infrastructure **#resilience**

'14 chokepoints' threaten food security
More must be done to protect key transport routes like the Panama and Suez canals, researchers warn.
bbc.co.uk

Laura Melo
@LauraMelo

Innovation, resilience: this is how small farmers improve food security in Cuban dry corridor **@WFP_Cuba @eu_echo**

2.5. Conflict resilience

Figure 15. Conflict resilience word cloud

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
- displacement and migration caused by weakened conflict resilience
- humanitarian response and strengthening resilience in contexts of violence.

2.5.1. What has changed since the last Scan?

In this Scan, conversations on conflict resilience continue to exhibit interest in migration, displacement and refugee movement triggered by war and violence, as well as prominent thematic overlaps with the food security sector.

Conflict resilience network maps show dynamics similar to those in the previous Scan, exhibiting networks that combine *broadcast* and *community* cluster dynamics (see Figure 16). This mirrors the way conversations on conflict

Figure 16. Influence map of conversations on conflict resilience
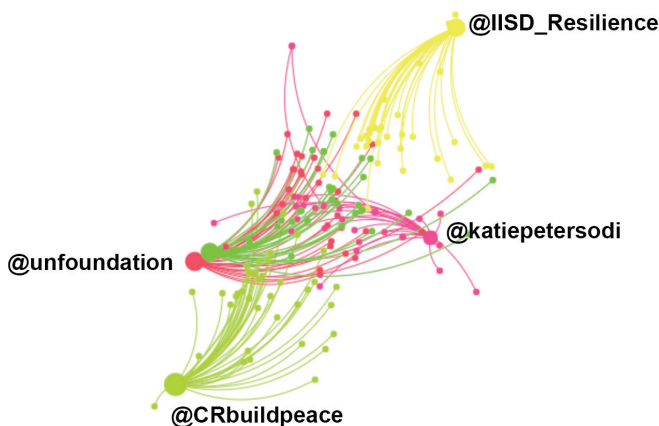
resilience are generated, being driven by a number of established institutions and experts on the topic, but also discussed from a number of perspectives (e.g. humanitarian responses vs displacement and migration in various regional contexts).

2.5.2. Top influencers on conflict resilience:
- @CRbuildpeace: Conciliation Resources is an independent international peace-building organisation
- @IISD_Resilience: #Sustdev policy research on climate adaptation, food security and environmental issues in conflict and peace-building
- @katiepetersodi: Katie Peters, Research Fellow, ODI
- @unfoundation: United Nations Foundation.

Figure 17. Sample tweets

FAO Newsroom
@FAOnews

Water: These remarkable stories of survival and resilience in #DRC where conflict has caused a rise in hunger. **Youtube.com/ water?v=2AIYgP…**

IISD Resilience
@IISD_Resilience

DRC's ecosystems and wildlife are at risk. Read our blog on how conflict-sensitive conversation can help: **iisd.org/blog/ conserving …**

Gustavo Gonzalez
@ggonzzalezz

How can we build #resilience in very practical terms and, particularly in the midst of a **#conflict**? Just click here: **fao.org/emergencies/re …**

2.6.   Urban resilience

Figure 18. Urban resilience word cloud

Conversations on urban resilience focus on:

- the impact of climate change on urban resilience
- the role of collaborative design and collective problem-solving in building more resilient cities
- spatial justice
- ways to strengthen urban resilience against disasters and natural hazards
- mainstreaming the concept of urban resilience.

2.6.1.   What has changed since the last Scan?

There is a big spike in conversations on urban resilience in the second quarter of 2017, visibly driven by the #100RCsummit. This has resulted in a greater sub-thematic diversity for urban resilience in this Scan. Conversations on collaboration to improve urban resilience are most significant.

In this Scan, urban resilience shows much greater interactions between the nodes when compared to previous Scans (see Figure 19). This can be partially attributed to the #100RCsummit in July 2017, which caused a significant spike in conversational presence in this sector.

Figure 19. Influence map of conversations on urban resilience
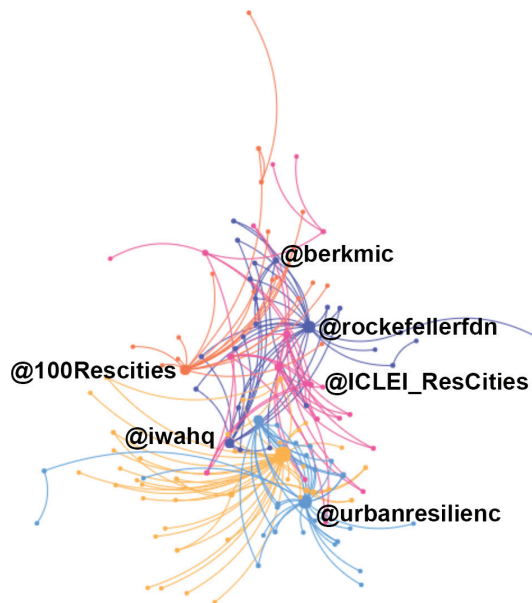
2.6.2.   Top influencers on urban resilience:

- @Berkmic: Michael Berkowitz, President @100ResCities, @RockefellerFdn
- @100ResCities: 100 Resilient Cities – Project by @RockefellerFdn helps cities become more resilient to the shocks and stresses of the 21st century
- @IWAHQ: International Water Association
- @RockefellerFdn: The Rockefeller Foundation
- @ICLEI_ResCities: Resilient Cities is the leading global forum on urban resilience
- @UrbanResilienc: Urban Resilience – professional tools and innovative solutions for urban design, citizen engagement and community sustainability solutions.

Figure 20. Sample tweets

Thomson Reuters Fdn
@TR_Foundation

Urban **#resilience** is no longer just a buzzword, it's a reality **bit.ly/2v9GN62** @SophieHares **#100RCsummit**

Culture of Health Eq
@CofHEQ

RT **@RockefellerFdn:** The true power of the urban **#resilience** movement lies in collective problem solving.

Building Network Connections - 100 Resilient Cities
Today is when our community of resilience practitioners will get down to work. Yesterday was an inspirational look at how far we've come and the limitless
100resilientcities.org

Mitch Landrieu
@MayorLandrieu

As cities grow, issues that impact urban security – public safety, resilience, economic opportunities – are key to strengthening cities.

Urban Array
@urcanarray

#100RCsummit "The Future of Urban Resilience" starts with **#collaboration goo.gl/uxQjKZ #socent #give1st #urbanarray**

The Future of Urban Resilience - The Rockefeller Foundation
This week at the 100 Resilient Cities 2017 Urban Resilience Summit, leaders from across the globe have come together to create a path to a resilient future.
rockefellerfoundation.org

2.7. Water resilience

Figure 22. Influence map of conversations on water resilience

Figure 21. Water resilience word cloud

communities
floods agriculture
shortage drought
food

Conversations on water resilience focus on:
- strengthening water resilience of communities in flood and drought-prone areas
- diversification of water sources to strengthen water resilience
- clean water infrastructure in urban and rural contexts
- impact of access to water for agriculture on food security
- adaptation strategies to water scarcity.

2.7.1. What has changed since the last Scan?

Conversations about droughts, floods and access to water for drinking and agriculture still feature most prominently in the water resilience sector.

Due to their thematically cross-cutting nature, water resilience networks exhibit a community structure similar to, if not as dense as, that of climate resilience (see Figure 22). These are largely expert-driven conversations, with overlaps with conflict, agriculture and food security networks.

@ClimateAdapt
@TR_Foundation
@meganrowling
@who
@wwatercouncil
@GetZilient

2.7.2. Top influencers on water resilience:

- @ClimateAdapt: Climate Adapt, Climate adaptation, urbanisation, resilience and transformation for a sustainable future
- @wwatercouncil: World Water Council
- @WHO: World Health Organization
- @meganrowling: Megan Rowling, journalist with Thomson Reuters Foundation. Editor of http://zilient.org
- @GetZilient: A global network developed by @RockefellerFdn, @TR_Foundation
- @TR_Foundation: Thomson Reuters Foundation.

Figure 23. Sample tweets

Hardlife Mudzingwa
@hardie1982

Replying to **@CHRA_Zim**
@BenManyenyeni @BAMutingwende

With changing & varying climate patterns, wetlands preservation is a viable mitigation & resilience strategy on **#water** provision. **#wetlands**

World Bank Water
@WorldBankWater

DYK: Diversifying water resources can lead to increased resilience? Rainwater, seawater, and **#wastewater** all count: **wrld.bg/HXwf30dvEmn**

Alertnetclimate
@alertnetclimate

Water for cows or goats? The best way to boost #resilience isn't always clear **tmsnrt.rs/2s5jDJW** **#climate @Oxfam @ODIclimate**

2.8. Economic resilience

Figure 24. Economic resilience word cloud

Conversations on economic resilience focus on:
- ways to improve disaster recovery by focusing on economic resilience strategies
- the role of the private sector in strengthening economic resilience
- development aid and economic resilience.

2.8.1. What has changed since the last Scan?

There are fewer conversations on economic resilience than in previous Scans, especially those in relation to strengthening economic resilience in contexts experiencing waves of migration. The role of business and the private sector for economic resilience, responses to economic crisis and economic empowerment of vulnerable communities remain key topics. There is a notable regional focus on Southeast Asia and China.

Economic resilience network maps show fewer conversations across scattered communities (Figure 25).

Figure 25. Influence map of conversations on water resilience
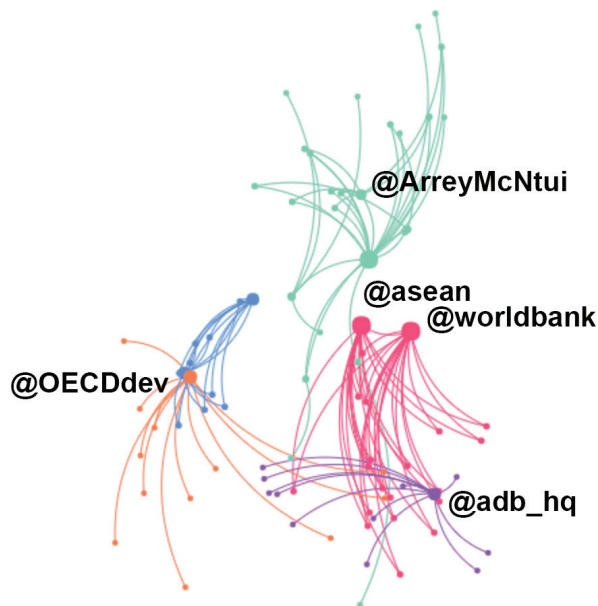
2.8.2. Top influencers on economic resilience:
- @ArreyMcNtui: Arrey E. Ntui, author of *Murdering poverty: how to fix aid*
- @ASEAN: Association of Southeast Asian Nations
- @OECDdev: Organisation for Economic Co-operation and Development
- @WorldBank: World Bank
- @ADB_HQ: Asian Development Bank.

Figure 26. Sample tweets

Palgrave Comms
@PalCommsOA

Measuring urban economic resilience could tell us how to analyse cities' response to shocks like social unrest

Quantifying urban economic resilience through labour force…
Resilience is increasing rapidly as a framework to understand and manage coupled human–natural systems. Yet the concept of resilience is rarely quantified. Here we quantify system resilie…
nature.com

Brad Kading
@ABIR_Bermuda

@InsDevForum Good example of #reinsurance aiding economic and human resilience

Reinsurance News @NewsReinsurance
Reinsurance industry helps World Bank secure $500m pandemic facility backing reinsurancene.ws/reinsurance-in…
WORLD BA
> IDA | WORLD BANK GI

Frank Mechielsen
@FrankMechielsen

Dimensions of social and economic resilience in #Kenya and #Bolivia #SustainableFood @10YFP @hivos @IIED @HivosAmLatina @hivosroea @the_dti

Dimensions of SER
❖Buffer Capacity (livelihood assets, functional and response diversity, spatial and temporal heterogeneity)

❖Self-organisation (Globally autonomous and locally interdependent, Socially self-organized, Ecologically self-organized, Appropriately connected, Reasonably profitable.)

❖Learning and adaptation (Knowledge of threats and opportunities, building of human capital, reflective and shared learning, functional feedback mechanism, knowledge legacy and identity)

2.9. Reflections on Twitter analysis

Figure 27. Thematic distribution of Twitter conversations on resilience
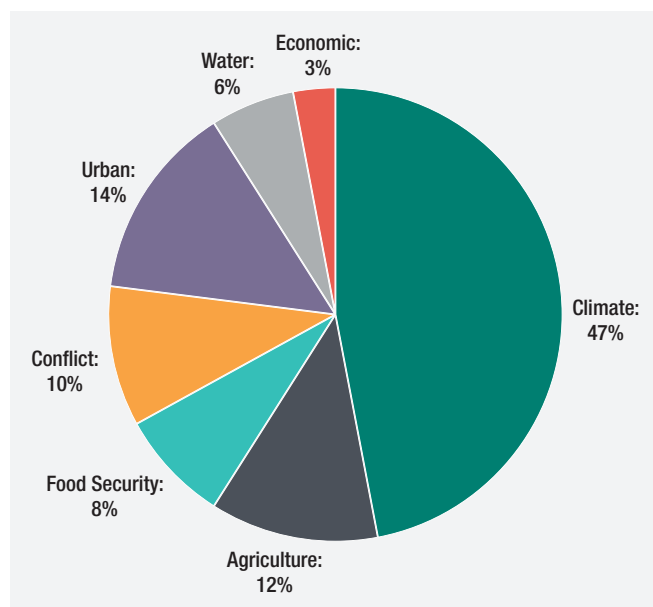
2.9.1. What does Twitter discuss about resilience?

The pie chart above shows a breakdown of tweets in the datasets acquired for this Scan. This breakdown was achieved by performing keyword analysis, then sorting the data into categories representing the seven resilience sectors studied in this Scan. Due to the vast volume of human-generated data on Twitter, this process is performed using a textual analysis API, and while the results are weighted approximations, they are adequate for the purpose of gaining insights into the dominant conversational themes on Twitter. As in previous Resilience Scans when looking at Twitter, climate resilience is the most conversationally prominent and has the most far-reaching thematic overlap with other resilience contexts. In the present Scan, urban and agriculture resilience have denser conversational clusters and more conversational visibility. The opposite is true with the economic resilience sector. Themes of technology, innovation, context-appropriate solutions and the use of data for analysis and response continue to feature as common denominators across all sectors.

2.9.2. Who tweets about resilience?

Institutional voices continue to enjoy the highest discursive visibility, largely because of the professional social media management resources most institutions are able to employ. However, a notable trend, observed in the list of top influencers, is that more individual experts and academics are joining the conversations and acquiring their share of engagement.

2.9.3. How is resilience tweeted about?

Due to the dominant mode of resilience tweets being more expert-driven, formal and link broadcasts (i.e. tweeting links to blog posts, articles, papers, etc.) than discursive interaction, a defining feature of these conversations is the expert/institution 'echo chamber' effect. That is, aside from a few exceptions, there is little engagement between top Twitter resilience experts and wider Twitter communities that may be of relevance to resilience themes, but which do not specifically focus on resilience. However, there are slight variances in this observation according to sector. More academics and journalists are joining various conversational circles, most notably the urban and agriculture sectors. Additionally, most conversational clusters are driven by a few very central and visible influencers, as shown by a comparison of the conversational networks in previous Scans. There is significant overlap between several topic networks, such as the water, agriculture and food security sectors, and the conflict and food security sectors.

3. Resilience in the grey literature

Our examination of the grey literature on resilience published in July–September 2017 includes 28 articles from research and private-sector institutions and humanitarian and development agencies. These span seven broad themes: finance and investment for resilience; urban resilience; climate and risk information; hard and soft infrastructure; agriculture and food security; fragility, conflict and governance; and taking stock of resilience concepts and approaches.

3.1. Finance and investment for resilience

Grey literature on finance and investment for resilience suggests that:

- insurance can contribute to all three 'dividends' of investing in building resilience
- working with local markets following a disaster can inject cash into the economy, improve access to finance, provide economic opportunities for affected people and protect local networks
- cash transfer programmes have short-term benefits for resilience-building, with cash-for-work programmes particularly benefiting the capacities of women.

Five reports relating to aspects of finance and investment for resilience were published in the last quarter. They address the 'triple dividend' of investing in resilience, the implications of political institutions for governing for resilience, and cash- and market-based programmes in disaster resilience. There is some overlap with the urban resilience theme below, as many of these publications also address aspects of DRR and recovery in urban settings.

The triple dividend of resilience framework recognises the benefits of investment in DRM, even in the absence of disaster, by stimulating economic activity through reduced disaster risk (the second dividend), and by delivering social, environmental and economic co-benefits (the third dividend), in addition to averting disaster losses (the first dividend) (Surminski and Tanner, 2016). It features in two publications. An ODI working paper by Weingärtner et al. (2017) finds examples of all three dividends in the use of

disaster risk insurance in developing countries. It directly compensates losses, and can help to reduce long-term negative impacts of disasters for payout beneficiaries, though the evidence base is thinner than might be expected. The expectation that a payout will be received when insured losses occur can increase risk-taking and drive investment even in the absence of disasters, and therefore insurance can stimulate economic activity by reducing actual and perceived disaster risk. In addition, while there is relatively limited evidence available regarding the social, environmental and economic co-benefits of insurance, the available research suggests that disaster risk insurance can have positive political impacts and enhance non-material wellbeing.

RAND Corporation published a Resilience Dividend Valuation Model (RDVM) and accompanying guide (Bond et al., 2017a, 2017b). The RDVM was developed by the RAND Corporation in partnership with The Rockefeller Foundation to provide a modelling framework to estimate the costs and benefits of resilience projects, including quantifying the resilience dividend. The report also presents a series of case studies of the model applied in Bangladesh, Nepal, Pakistan, Vietnam and the US, with the lessons learnt regarding quantifying the resilience dividend, the role of behaviour, data and evidence, and about model limitations. Lessons learnt include the understanding that the 'business as usual' scenario is critically important as a counterfactual when quantifying the resilience dividend, and that the extensive data needed is an important model limitation.

A Mercy Corps (2017a) report looks at how working with local markets in disaster response and recovery can help to build resilience. It finds that doing so can inject cash into the economy, improve access to finance, provide economic opportunities for affected people and protect local networks. To ensure that response maximises long-term impact, the report recommends that donors and implementing agencies should: adapt approaches from longer-term development programmes to support disaster response and recovery; implement flexible programmes focusing on rebuilding local economies and supporting local businesses alongside – not after – basic-needs response; analyse local markets frequently and work in

partnership with local businesses and other actors to support more widespread and sustainable recovery; and document the impact of market-based interventions on the speed and sustainability of disaster recovery.

Two publications explore aspects of cash transfer programmes, which are increasingly a part of humanitarian response. A report from CARE (2017) examines the impact of cash transfer programmes (including cash-for-work schemes) on resilience, based on a study of these schemes in Zimbabwe, Niger and Ethiopia. It finds that unconditional, multi-purpose cash assistance can be effective for building shorter-term absorptive resilience by boosting consumption and reducing negative coping strategies. Longer-term objectives require more complex programming. Recommendations include targeting female-headed households; maximising the length of time that transfers are provided to households; integrating provision of advice and access to key information within the dissemination of cash transfer information; using a robust formula to calculate appropriate transfer values, using real labour and commodity market supply prices; deploying conditional cash transfer schemes through cash-for-work programmes in crisis-affected or at-risk areas that are not experiencing spiralling food insecurity or risk of famine; and that cash transfer programmes should be coupled with collective-action structures to support grassroots transformative change.

A working paper from the International Institute for Environment and Development (IIED) (Nesbitt-Ahmed, 2017) explores how emergency cash transfers can influence gender inequality and women's economic empowerment. The findings are based on analysis of the experiences of beneficiaries and non-beneficiaries of cash transfer programmes in Kathmandu Valley, Nepal, after the April 2015 earthquake. The study finds that men and women tend to make decisions jointly about how to use the emergency cash grants, and also jointly discuss household expenditure. Cash-for-work programmes gave women more control and more chance to decide how to use the money they earned, relative to the cash grants. However, cash transfer programmes were mostly too small to make long-term changes to women's choices. Governments and international/national organisations receive recommendations that these programmes must work to be inclusive and to minimise tensions within communities, that they should work with existing social security schemes, and that they should support cash-for-work programmes that specifically aim to economically empower women and vulnerable groups – including promoting women's employment and equal wages in reconstruction – and provide training opportunities for women.

3.2. Urban resilience

Grey literature on urban resilience suggests that:

- local concerns such as pollution, health, safety or electricity access are important entry points for urban climate action
- low-tech, ecosystem-based resilience solutions that can be supported by local people are often well suited to developing-country cities, as they are easier and cheaper to implement and maintain, and require less expert knowledge
- resettlement and relocation of disaster-affected or at-risk communities should be seen as a last resort, and decisions should involve all stakeholders.

Urban resilience emerges again as a major theme in this quarter. Eight publications address urban resilience, with most of these focusing on urban climate change resilience. Two papers from the Institute for Social and Environmental Transition (ISET) explore community involvement in urban or peri-urban resilience-building.

The United Nations Office for Disaster Risk Reduction (UNISDR, 2017) presents a report, derived from a baseline study in partnership with the Center for Urban Disaster Risk Reduction and Resilience (CUDRR+R), which identifies the authority and capacities that local governments possess to implement actions relating to DRR and making cities resilient. The report emphasises the importance of considering their powers and responsibilities to address problems of an 'urban era'. The study involved the participation of 151 cities, local governments and 'Making Cities Resilient' campaign partners, and examined seven types of authority and capacities, and levels of legal or authorised responsibility for undertaking 13 different types of resilience-building actions. It found that local governments have the highest levels of powers to 'develop a city vision or strategic plan that may include concepts of resilience', and that they have the lowest level of powers for developing and enforcing the use of building codes and connecting to early warning systems. Many local governments are 'fully responsible' for risk-informed urban planning in their locality. However, while many local governments are accountable for DRR actions, they often have limited powers for delivering them. For example, while 88% of local governments are fully or partially responsible for undertaking risk analysis, 25% do not have sufficient technical capacity to do so.

100 Resilient Cities (100RC, 2017) outlines the ways that partner cities are taking climate action. So far, 30 Resilience Strategies have been published by 100RC member cities, containing more than 1,600 initiatives, and these cities have already leveraged over US$535 million in funding from private, public and philanthropic sources to

support implementation. These plans vary regionally and tend to be oriented around local concerns. African cities' strategies tend to focus on energy and waste management, Asia-Pacific cities tend to focus on disaster preparedness, Latin American cities generally target social cohesion, European cities are innovating around urban design, while North American cities prioritise initiatives that promote socioeconomic equity. The report outlines major initiatives in seven cities around the world, highlighting the different approaches and initiatives, from integrating informal communities in Medellín, Colombia, to managing urban forests and natural assets in Melbourne, Australia.

A policy brief from the Centre for Policy Research in India examines how cities can use existing governance arrangements to promote and scale climate efforts, based on a case study of Rajkot (Bhardwaj and Khosla, 2017). Rajkot is the only city in India whose mayor is part of the Global Covenant of Mayors on Climate and Energy, and the city is a leading light on climate action. The policy brief recommends that cities should use locally specific urban concerns and objectives as an entry point for climate action; that cities focus on implementing state and national schemes that include climate components; and that creative ways for cities to adapt urban development directives to include climate actions are considered. For example, Rajkot Municipal Corporation was awarded a Housing and Development Corporation Award for cost-effective housing for incorporating passive cooling, lighting and ventilation, and rainwater harvesting features, within local building design guidelines, despite the absence of climate objectives in national and state housing guidelines. Enabling climate action in cities is a collaborative exercise, requiring conducive policy framework at the national and state levels, with leadership and creativity by the municipal corporation.

A working paper by Butterfield et al. (2017) outlines practical options for resilient pathways in African cities, underpinned by 17 case studies. While each case study is context specific, a broad series of lessons emerged that include: building climate-resilient infrastructure and creating low-tech solutions when possible, and low-tech adaptation solutions that can be managed or supported by local people. Such options are often among the most transferable solutions for Africa, and can offer greater potential to empower the most vulnerable. The working paper identifies ecosystem-based and community-based approaches as being easier to implement, and more cost-effective to maintain, than high-technology solutions which require expert knowledge. Another lesson highlighted is the need to implement projects that raise awareness and have multiple benefits. For example, catchment management and community reforestation initiatives in Cape Town restored and preserved ecosystems to reduce climate risk, and also created local

African cities' strategies tend to focus on energy and waste management, Asia-Pacific cities tend to focus on disaster preparedness, Latin American cities generally target social cohesion, European cities are innovating around urban design, while North American cities prioritise initiatives that promote socioeconomic equity.

employment opportunities. Projects that integrate public participation and job creation are also more likely to attract political support and funding.

Two publications (Jain et al., 2017a, 2017b) discuss disaster-related resettlement and relocation in cities. Communities affected by disasters are often relocated by governments, against their own wishes, in the name of future risk reduction or relief. Presenting the results of a two-year research project in cities across three continents, a Climate and Development Knowledge Network (CDKN) 'Essentials' report summarises recommendations on the appropriateness of, and best practices for, disaster-related urban resettlement and relocation (Jain et al., 2017a). It finds that, while resettlement and relocation can reduce people's exposure to hazards, in most cases it leaves people worse off in socioeconomic terms. Planning should prevent the location of new settlement in hazard-prone areas to avoid risk accumulation, but for existing settlements, resettlement should be considered a last resort after alternatives to resettlement, such as options for on-site upgrading/rebuilding, have been discussed. Decisions must be made via consensus-building processes with all stakeholders. Policies and procedures must protect people's rights, and in many cases legal frameworks need to be strengthened. The second publication, an IIED Briefing (Jain et al., 2017b), reflects on the specific experiences of relocation in Chennai, India. India has no legal frameworks or compensation mechanisms for people who are displaced or relocated after a disaster, as it does for relocation when land is acquired for development, and relocation is often used as another form of eviction for people who have no security of tenure over their land. The briefing recommends that the authorities work with the communities in question in making decisions, and that forced evictions in response to disasters must stop – they are counterproductive, as they undermine people's agency, erode trust and exacerbate inequality. Relocation should

be done as part of a long-term recovery process in a mutually agreed, dignified, risk-reducing way, alongside efforts to risk-proof the development agenda.

Two ISET working papers focus on community involvement in urban or peri-urban DRR. Tuyen and Tyler (2017) describe the different experience of peri-urban villages involved in mangrove restoration projects funded by The Rockefeller Foundation under the Asian Cities Climate Change Resilience Network (ACCCRN) initiative. The five mangrove seedling plantations had significantly different outcomes, with rates of seedling survival as high as 80% and as low as 0%. While the co-management approaches adopted were similar, the study identifies important factors undermining the success of mangrove restoration in the low survival cases. These include limited prior familiarity of villagers with mangroves, low dependence on aquatic harvesting, the poor local leadership for mangrove planting and protection, inconsistent application of informal tenure rights, and poor quality of habitat for mangrove seedlings. Community support was weakened further due to the failure of local forest management authorities to find a successful mechanism for long-term benefit-sharing; there is a need for legal provisions under collective co-management agreements to help compensate for the short-term exploitation interests of households who have no long-term stake in the mangrove plantations.

Nguyen and Tyler (2017) outline an experimental co-management approach for urban riverbank erosion management in the city of Can Tho, Vietnam. The approach involves a mechanism for the funding, in which both local government and local residents make financial contributions, construction and maintenance of infrastructure for riverbank stabilisation and erosion control. Under this model, local government and communities collaborated to test low-cost and locally grounded riverbank stabilisation measures, where local people were involved in planning, decision-making, construction oversight, and contributing labour (960 person-days) and finance (US$80 million, equivalent to 170 million Vietnamese dong). The community's plan, and local people's contribution to labour and finance, was more ambitious than envisaged and enabled the project to expand. However, the model ran into difficulties due to the limited time that poorer local people could dedicate to the project, and due to limited capacity of government staff at community and ward levels. The commitment of local leaders and the interest of local people is critical for co-management to work, particularly because of limited human and financial resources for community-based DRM at national or city levels.

3.3. Climate and risk information

Grey literature relating to climate and risk information suggests that:

- radio 'listening groups' can help to disseminate accessible weather and climate forecasts to rural communities, but benefits are hindered by lack of understanding of how to apply this information, limited access to radio equipment, and other factors
- the risk of populations being displaced by disasters is distributed highly unevenly across the Greater Horn of Africa, concentrated in countries with densely populated and flood-prone river basins
- migrants who are not well integrated into society, especially those who do not speak the local language, may be poorly informed about impending hazards
- complex climate science can, and must, be communicated simply, with careful consideration of the needs of the target audience.

The four studies outlined here discuss issues relating to climate risk information: two focus on community or particular groups' access to weather and climate forecasts, a third discusses efforts to further climate change attribution science and the communication of climate change, while the fourth presents baseline information on displacement risk across the Greater Horn of Africa.

A case study from Building Resilience and Adaptation to Climate Extremes and Disasters (BRACED, 2017a) explores the impact of climate information on resilience in Ethiopia, drawing on experiences of the 'listening groups' that gather together to access weather and climate updates via the radio. People are benefiting from receiving more accurate weather and information to complement traditional weather forecasting, and are beginning to translate radio messages into action. However, illiteracy still inhibits access to climate information services, along with a lack of knowledge as to how to apply scientific climate information in decision-making. The study also finds that progress in acting on radio messages is hindered by a lack of sufficient technical and stakeholder support, including limited access to radio equipment. Women tend to be underrepresented in the listening groups, and do not speak up as much as men, and therefore increased training for women on the application of climate information is deemed beneficial.

A further case study, this one by the International Centre for Migration Policy Development, examines the immediate and longer-term consequences of the 2011 Thai floods on migrants from Myanmar, Cambodia, Lao PDR and Vietnam (Bravi et al., 2017). It finds that migrants who were better integrated into Thai society – and particularly those able to understand and speak the Thai language – were more aware and better informed, and could prepare for the impending floods. Some less well-integrated migrants only realised

the severity of the situation when they saw the floodwaters rising. Few migrants moved to government-operated shelters, preferring instead to find shelter with friends, employers, or other temporary higher-ground shelter – registration processes in the shelters may have discouraged migrants with irregular status from seeking refuge there. While most migrants interviewed stayed in Thailand during the crisis – whether voluntarily or not – many said that they would want to return to their home country if such a crisis were to happen again. Vulnerable groups, such as low-skilled and undocumented migrant workers, should be specifically targeted in disaster management plans.

Raising Risk Awareness (RRA), a new project from World Weather Attribution and CDKN, seeks to enhance understanding of whether and how climate change is affecting the likelihood and severity of extreme weather events (extreme event attribution), based on case studies in Bangladesh, Ethiopia, India and Kenya. It aims to inform climate risk management efforts and to incentivise governments to secure greater and faster action to reduce GHGs. A synthesis report (RRA, 2017) from the project summarises its activities, outcomes and, for organisations wishing to build on this foundational work, the emerging lessons on how to build extreme event attribution capacity, awareness and use in developing countries. Observations from this work include the differences in preferences between stakeholder groups and between countries in how probability, frequency, intensity and uncertainty of extreme event attribution should be communicated, and the different incentives driving interests of officials. For example, in India, media reporting is an important factor driving the attention of politicians and policy-makers.

Displacement of populations in the Greater Horn of Africa is a complex and large-scale phenomenon, with a range of interlinked triggers and drivers. A report by UNISDR and the Internal Displacement Monitoring Centre (IDMC) (UNISDR and IDMC, 2017) provides a baseline on displacement risk against which to measure progress. It outlines the scale, scope and distribution of risks associated with sudden-onset hazards and the methodology used to calculate them, and defines key concepts, data sources and metrics. Key findings include the way that absolute displacement risk is distributed extremely unevenly across the region, driven mainly by exposure factors and concentrated in countries with densely populated, flood-prone river basins. Countries such as Somalia, Rwanda and Burundi have especially high levels of displacement risk due to high vulnerability. There are significant conceptual and data gaps for displacement associated with drought, which is not systematically recorded. Of the 11 countries reviewed in the report, only Ethiopia, Kenya and Uganda systematically collect data on disasters.

3.4.   Hard and soft infrastructure

Grey literature relating to infrastructure suggests that:

- the World Bank has new guidance for the prioritisation of climate-resilient investments in road infrastructure
- wetlands are important natural infrastructure that enhance resilience to water-related hazards, and wetland management should be embedded within DRR policies
- in designing climate-resilient water infrastructure, decision-makers should 'go beyond the project' to maximise co-benefits with other sectors and stakeholders.

The three reports in this section discuss the resilience of water and transport infrastructure investments, and also nature-based infrastructure for DRR.

Recognising the need to ensure that water infrastructure investments are resilient to climate variability and long-term change, a review of six CDKN-funded projects (Hurford et al., 2017) presents five critical factors for increasing the climate resilience of water infrastructure. The five factors are:

- simple and effective communication of climate risks and uncertainties, placed within the wider context of non-climate risks and vulnerabilities to inform planning and design
- involving the right stakeholders at each stage
- capitalising on entry points into decision-making and planning processes to maximise the opportunity for effective change
- selecting, designing and operating infrastructure to minimise negative impacts and maximise co-benefits with other sectors and stakeholders ('going beyond the project')
- building institutional capacity for assessment, design and financing, tailored to the particular gaps and needs of the relevant national government agency or river basin organisation.

A practitioners' guide from the World Bank (2017) provides guidance for the prioritisation of climate-resilient investments in road infrastructure, presenting a general methodology, a conceptual framework, and a case study of the process conducted in Belize. It is geared towards contexts where data is scarce, but where institutional memory can be harnessed. The conceptual framework outlines six modules, namely (1) definition of objectives and scope of the prioritisation process, (2) understanding the governance context and establishing the institutional arrangements, (3) collection of data, (4) evaluation of criticality, (5) assessment of risk/exposure from climate-related hazards, and (6) informed decision-making.

Kumar et al. (2017) highlight the importance of wetlands as soft infrastructure for enhancing resilience to water-related hazards such as floods, droughts and storm surges. Wetlands constitute natural, cost-effective DRR infrastructure (increasingly recognised as part of the eco-DRR approach), which can mitigate hazards and enhance the resilience of communities living across entire river basins or coastal zones. Protecting wetlands can also have wider benefits for water quality, food and energy security, as well as human health. The authors recommend that policy-makers should embed wetland management with ecosystem-based DRR policies and programmes, alongside other 'hard' infrastructure and risk management measures, and promote the collaboration of development, humanitarian and environmental sectors to deliver wetland-related solutions for addressing disaster risks.

3.5. Agriculture and food security

Grey literature relating to agriculture and food security suggests that:

- case studies from Kenya and Cameroon indicate that farming communities are taking measures to adapt to changes in climate, and that this adaptation is gendered (e.g. men are more likely to seek work elsewhere)
- new evidence indicates that the adoption of climate-smart agricultural practices has positive outcomes for sustainable agriculture production
- assistance for building resilient food systems should invest in national policy institutions and create asset-building opportunities, alongside providing emergency support, to address both short- and long-term risks.

Four reports discuss aspects of agriculture and food security, presenting new evidence on coping strategies, on the costs and benefits of climate-smart agriculture, along with lessons for building resilient food systems in famine-prone areas.

An IIED Country Report (Wekesa et al., 2017) explores key trends over recent decades in climate, livelihoods, food security, crop diversity and social capital, along with traditional smallholder innovations to address climatic and socioeconomic challenges, in Mijkenda communities in Kenya. Smallholders in Kenya are already affected by climate changes, including increased extreme events and less predictable rainfall, especially in semi-arid and dryland areas. In response to these changes, smallholders have taken measures to enhance productivity and resilience, such as crop diversification, the use of traditional crop varieties, new planting techniques and wild tree domestication. Crop production has been decreasing in importance as a livelihood strategy, a trend attributed to climatic changes and to increased migration to urban areas for employment. Net income has risen among most communities, due to

Wetlands constitute natural, cost-effective DRR infrastructure (increasingly recognised as part of the eco-DRR approach), which can mitigate hazards and enhance the resilience of communities living across entire river basins or coastal zones.

income diversification (such as tourism and small business), except in Duruma where it decreased due to higher spending on food as a result of low crop and livestock productivity and prolonged droughts.

A discussion paper (Nkengia-Asi et al., 2017) from the International Food Policy Research Institute (IFPRI), presents the findings of research assessing how men and women in Cameroon's Southwest region differ in their vulnerability and coping strategies for climate change impacts. Most respondents, male and female, had observed a change in climate variables, such as the timing and length of the rainy season. Coping strategies used by men and women include income diversification, planting of early-maturing crops and the use of pest-resistant seeds. However, men tend to move away from the area to seek paid jobs in cities, while women tend to diversify their livelihood activities while remaining within their communities. Understanding gendered differences is important for developing gender-sensitive policies and programmes and for more inclusive adaptation strategies.

An International Center for Tropical Agriculture (CIAT) working paper sets out the results of cost-benefit analysis for climate-smart agricultural practices in Ghana's coastal savannah agro-ecological zone (Ng'ang'a et al., 2017). The adoption of climate-smart agriculture is vital for sustainable agricultural production in Ghana, but evidence of the cost-effectiveness of adopting climate-smart practices has been lacking. The study examines private and social costs and benefits of selected practices, and finds that, overall, climate-smart agricultural practices have positive values: they improve water availability, reduce soil erosion, increase biodiversity and soil biodiversity, and improve air quality. However, the working paper concludes that there is a need for a deeper understanding of trade-offs between different climate-smart agriculture practices.

A policy brief from IFPRI (Babu and Dorosh, 2017) examines lessons for building resilient food systems from success stories in famine prevention around the world. It outlines approaches to building resilience under three broad categories, namely policy-system, institutional and food-system resilience. Under policy-system resilience, the authors

highlight the importance of policy systems that balance the need to address food emergencies with investments in long-term development, of organising the coordination of responses at the highest possible level and investing in national policy institutions, such as research institutes and economic associations, that can help to put food debates related to emergency and long-term development on national policy agendas. In conflict situations, where key institutions often function poorly or not at all, the authors indicate that efforts to sustain local institutions and use them effectively in response and recovery can help to build institutional resilience. To build food-system resilience, external assistance for countries affected by drought should combine emergency support with the creation of asset-building opportunities and community capacity-building, to address both short- and long-term risks.

3.6.   Fragility, conflict and governance

Grey literature relating to fragility, conflict and governance suggests that:

- it is necessary to work with institutional realities in the application of new governance approaches, and also the need for an incremental and long-term process of convening actors and creating space for engagement between stakeholders
- as many of the central issues for the prevention and sustaining peace agenda are addressed in the Sendai Framework for Disaster Risk Reduction (SFDRR), implementation of this disasters framework would help to reduce both disaster and conflict risks
- market subsidy strategies and market systems change can have resilience-building benefits in fragile and conflict-affected states.

Three studies in this quarter focus on fragility, conflict prevention and governance, with one providing a broad view on governance and resilience, one examining international policy linkages, and the third looking at DRR in fragile contexts.

An ODI working paper examines how the realities of formal and informal political institutions influence approaches to building resilience (Fraser and Kirbyshire, 2017). Based on a review of existing literature and a series of case studies, the paper highlights issues associated with national–local government relations, political parties, state–society relations, clientelism and corruption, and traditional political institutions. To enhance governance for resilience, the paper highlights the importance of understanding political economy and power, including informal power structures, of acknowledging trade-offs in resilience outcomes, and of focusing on process over the production of technical outputs. An incremental and long-term process

of convening actors and creating space for engagement between stakeholders is needed alongside the application of particular governance approaches.

Stein and Walch (2017) assess the potential of the SFDRR as a tool for conflict prevention. They find that, while direct references to conflict are not included in the final text, the Framework addresses parallel issues to those that need to be addressed in a prevention and sustaining peace agenda. If properly implemented, the SFDRR would tackle socioeconomic, politico-institutional and environmental factors that affect both disaster and conflict risks. However, there are three significant challenges for DRR and the SFDRR specifically to be a prevention tool: the SFDRR's state-centric approach assumes the existence of functioning state governments to implement it, and so weak and fragile states often have the greatest need and also the lowest implementation capacity. Member states may be uncomfortable with the use of the Framework as a prevention agenda, as evidenced by the deletion of references to 'situation of foreign occupation and armed conflict' from the final SFDRR text, and DRR is often not a priority in contexts of acute emergency. Nevertheless, the SFDRR's prevention mindset could guide wider prevention efforts in the United Nations (UN) system, and it sets out a roadmap for a multidimensional approach to prevention that tackles the underlying causes of both conflict and disaster risk.

A briefing from Mercy Corps (2017b) investigates the links between market systems development and resilience in fragile contexts, focusing on analysis from three countries in South and Southeast Asia. Market systems development aims to address the underlying constraints that limit people's access to, and participation in, the market. It finds that social capital and the nature of relationships between producers and market actors impact their resilience – for instance, a group farming model helped farmers to pool their risk in new and uncertain market sectors, provided that social capital in the community is strong. Training local people, rather than bringing in outsiders, helps to leverage existing relationships with farmers and market actors up the supply chain. The briefing finds that failure to address social norms and vulnerabilities (particularly when gender-based) undermines the resilience-building potential of market systems development.

If properly implemented, the SFDRR would tackle socioeconomic, politico-institutional and environmental factors that affect both disaster and conflict risks.

3.7. Taking stock of resilience

Grey literature that is taking stock of resilience building suggests that:

- while resilience has come a long way conceptually and as an operational approach, many challenges remain
- key challenges include the multiple interpretations of resilience, navigating trade-offs between different groups, and measuring resilience.

Two studies in this Scan take stock of progress on resilience as a concept and as an operational approach. One reviews from a more academic perspective while the other provides lessons via stories from a large resilience-building programme.

Tanner et al. (2017) combine expert interviews with a review of recent literature to outline challenges and debates in resilience policy and practice. The working paper highlights as key challenges the multiple, and often conflicting, interpretations of resilience, and the difficulty of attributing values and navigating the many trade-offs associated with resilience between different groups, locations and timeframes. Furthermore, narratives that appear to shift responsibility for building resilience onto vulnerable populations themselves have been criticised for depoliticising disaster risk. The paper presents a series of future challenges for resilience policy and practice that include whether and how to create more common definitions and metrics, and progress on tackling trade-offs and the distributional costs and benefits of resilience-building actions.

The BRACED programme released a report summarising lessons learnt to date on resilience via a series of stories (BRACED, 2017b). The countries covered by BRACED are disproportionately affected by climate-related disasters, so development and resilience-building in these countries is closely linked. Some lessons highlighted include: while access to reliable climate and weather information is vital for managing climate shocks and stresses, efforts must be made to build and maintain trust in forecasts; challenging and changing social norms to enable vulnerable groups – particularly women and girls – to gain control over decisions that affect their lives requires long-term, deep engagement with communities; and that measuring the progress of a resilience programme is challenging and resource intensive.

4. Resilience in the academic literature

This section introduces academic literature on resilience from the third quarter of 2017. It comprises 28 publications that span five thematic areas: agriculture and food security; conceptual approaches, indicators and measurements; culture, politics and power; health; and policy, planning and governance for building resilience.

4.1. Agriculture, livelihoods and food security

Academic literature on agriculture, livelihoods and food security suggests that:

- a range of common features – including integration, participation, system-based modelling and spatial explicitness – represent a more holistic model of farming for resilient agriculture
- local climate adaptation practices of subsistence fishing communities can diverge from what policy-makers or researchers suggest and therefore require greater consideration in policy-making
- the decision to diversify crops is driven by a large variety of motivations, but concerns around their household consumption may be the most decisive factor for farmers
- land degradation is closely intertwined with climate change: it can challenge the climate resilience of agricultural systems and land users, which, in turn, may increase pressures on ecological systems, further spiralling degradation
- increasing resilience in the production of nutritious and sufficient food requires a holistic approach that works across scales and across ecological and social interventions.

With a total of 10 papers, agriculture, livelihoods or food security are the most popular thematic areas in the academic literature scanned this quarter. Crop diversification as a farming strategy to increase resilience and enhance food security has been a recurrent theme n the literature of this Scan and that of previous quarters. Nordhagen et al. (2017) add to this debate by assessing perceptions and motivations that drive farmers' decision-making around crop choices in Papua New Guinea. The authors identify different groups of farmers, including so-called 'marketer-consumers', who are highly motivated by crop sale, and 'exhibitionists', who prioritise the 'show' values of crops. Despite the significant differences in attitudes and approaches towards diversification, results show that concerns around their household consumption are the most important contributor to farmers' crop choices across all groups. Climate and environmental resilience, though a potential co-benefit, was not generally a key driver of practising crop diversity in the study.

Bullock et al. (2017) argue that there is a need to reconsider how ecologists generally think about the resilience concept and its application to food security. The authors argue that resilience needs to integrate concerns around how food production responds to fluctuations (for instance climate variability), shorter-term changes (for example extreme weather events) and longer-term changes (such as an increase in average temperatures). These drivers can affect food production in different ways and at different scales. To increase the resilience in production of nutritious and sufficient food, according to Bullock et al., a holistic approach to resilience that works across scales and across both ecological and social interventions is required. This emphasis on a more holistic approach to support resilience in agriculture is echoed by Kenny (2017). This article argues that, at farm level, modelling can present a useful approach for integrating different types of capital to assess and make decisions around sustainable farm performance. For this, the author reviews various models that focus on natural, social, human or built capitals and how these relate to risk, resilience and wellbeing. This includes land-use models, agent-based models, system-dynamics models and participatory models. Despite the differences in modelling tools, Kenny (2017) suggests that a range of common features – integration, participation, system-based modelling and spatial explicitness – can be identified and should represent an integral part in a more holistic farm model.

Focusing specifically on the Ethiopian coffee sector, Moat et al. (2017) assess different scenarios for the impacts of climate change on production. Based on a combination

of modelling, remote-sensing and ground-truthing, the authors 'show that 39–59% of the current growing area could experience climatic changes that are large enough to render them unsuitable for coffee farming' (p. 1), assuming that there are no major other influences or interventions. In the presence of interventions, namely forest re-establishment or conservation and the relocation of coffee farming to more suitable areas, the model suggests that the production of arabica coffee could, in turn, increase at least fourfold. Though the model is not entirely comprehensive, in that it does not factor in other aspects, such as the impact of CO_2 concentration in the atmosphere or diseases and pests interacting with a changing climate, the article provides an example of how to analyse the resilience potential of different adaptive interventions in Ethiopian agriculture.

Land degradation is closely intertwined with climate change. It can challenge the climate resilience of agricultural systems and land users, which, in turn, can increase pressures on ecological systems, further spiralling degradation (Webb et al., 2017). Webb and his co-authors explore these linkages between land degradation, vulnerability and climate change (Figure 28), and suggest a range of strategies to support climate-resilient agriculture in this context. According to the authors, this entails (1) a better understanding of how socioeconomic, biophysical and biogeochemical factors interact, (2) the identification of vulnerabilities within agro-ecological systems, (3) an enhanced exchange of knowledge between different stakeholders across scales, and (4) innovative policy and management options that support the resilience of agro-ecosystems and minimise negative impacts from climate change.

Biffis and Chavez (2017) show how satellite technology and machine learning can help to assess the benefits and costs of climate and weather variability as well as actions to enhance resilience. The authors calculate the lowered costs of insurance by adopting resilient agricultural production technology, exemplified through irrigation infrastructure. The model developed for this purpose, the authors highlight, can help to guide risk management strategies at national level because it provides aggregate risk profiles as well as disaggregated information on crop vulnerability. Furthermore, Biffis and Chavez see it informing the design and economic evaluation of risk-transfer approaches. In a related article, Lewis (2017) calls for a more nuanced understanding of rainfall variability – beyond the common catch-all use of the term 'drought' – and its implications on food security. This is important, she highlights, because food security depends not only on meteorological characteristics, but is also strongly influenced by the socioeconomic context. In Ethiopia, climate variability in combination with a food system characterised by climate-sensitive livelihoods and smallholder farming have resulted in recurring food insecurity, especially in the most marginal and drier eastern parts of the country. The article highlights that increased resilience of smallholders, together with enhanced early warning and disaster response, can help to reduce the severity and frequency of food insecurity crises, but only a transformation of Ethiopia's food system will decidedly reduce hunger.

Figure 28. Links between agricultural vulnerability to climate change and land degradation
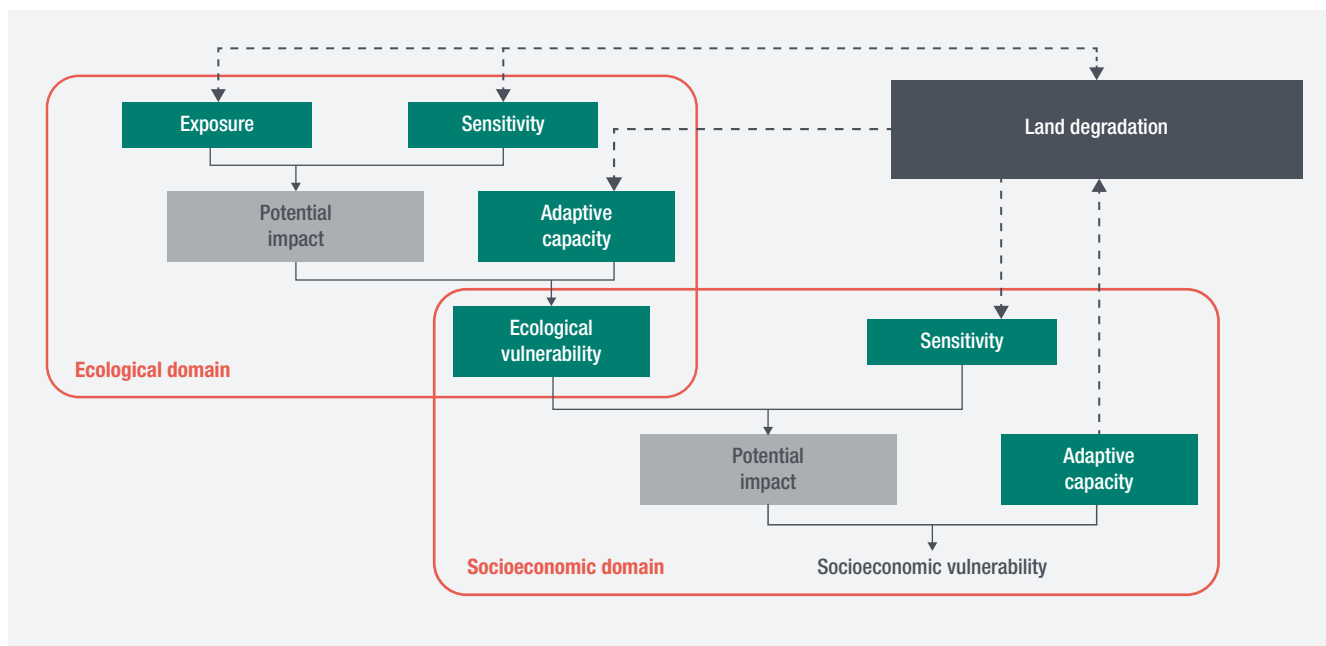
Source: Webb et al. (2017); solid arrows represent connections between the factors that determine vulnerability, whereas dashed arrows represent potential linkages between vulnerability and land degradation.

Smith and Frankenberger (2017) consider the relevance of households' different resilience capacities for food security impacts of flooding in Bangladesh in 2014. Their article presents a quantitative analysis of how resilience capacity bolstered households' wellbeing in the face of the floods. The authors combine cross-sectional and panel household surveys with satellite-based real-time drought and flood data, as well as information from monitoring and evaluation activities. Results show a negative impact of exposure on food security, but the higher the household resilience capacities, the more the effect of exposure decreases. Capacities in the analysis that matter most include bonding social capital, bridging social capital, access to services, exposure to information, women's empowerment, village governance and informal safety nets.

Whereas most of the academic literature in this section focuses on agricultural livelihoods, Savo et al. (2017) highlight the impacts of climate change on fisheries. To analyse observations and adaptation strategies of subsistence fishers to climate change, the authors conduct a meta-analysis of grey and peer-reviewed literature. Globally, fishers report shifting weather patterns, increased temperatures, SLR, coastal erosion and an altered range and behaviour of species. Locally developed adaptation strategies are, most frequently, based on diversification, but also entail, to a lesser extent, conservation or protection measures, mobility, storage, rationing, forecasting, market-based exchange, knowledge utilisation, selection, reorganisation of labour, resource-sharing and spiritual or religious practices. These practices used in subsistence fishing communities, the authors conclude, can diverge from the recommendations of policy-makers or researchers, and therefore require greater consideration in developing adaptation to climate change.

In the context of ecotourism, resilience assessments are a fairly new approach. Jamaliah and Powell (2017) capture local communities' views on resilience across four dimensions – environmental, economic, governance and social – in the Dana Biosphere Reserve in Jordan. All four, the authors argue, are expected to support ecotourism systems in adapting to and coping with climate change, and residents' opinions are key for effective management of resilient ecotourism in the context of climate change. Across the communities in and around the Reserve, resilience levels were judged as moderate. On average, governance resilience was perceived as the lowest, while environmental resilience had the highest mean. This, the article concludes, might be related to Jordan's policies around managing protected areas, which prioritise environmental over the other resilience components.

4.2. Conceptual approaches, indicators and measurement

Academic literature on conceptual approaches, indicators and measurement suggests that:

- rigorous impact evaluations are possible in data- and resource-constrained contexts of resilience interventions if they address the use of counterfactuals, internal validity, social interaction threats and matching techniques
- the causes of social-ecological system collapse may be diverse and can lead to different types of collapse
- subjective approaches to measuring resilience may improve the understanding of resilience drivers, lower the questionnaire-burden for respondents and support resilience comparisons across cultures.

Many of the existing frameworks for measuring resilience are too data-demanding, too academic or too time sensitive to meet practitioners' needs for rigorous monitoring and evaluating of resilience interventions, which are currently increasing in number and popularity with non-governmental organisations (NGOs), donors and development agencies (Béné et al., 2017). To fill this void, Béné and colleagues propose a framework for conducting impact assessments that combines rigour and operationality in the resource-, time- and data-constrained contexts of most interventions. This Resilience Impact Assessment (RIA) framework uses impact evaluation methodology, with the choice for a specific tool depending on timing and purpose of the evaluation, the availability of a baseline, opportunities for data collection and the potential for control or comparison groups. As a practical example, the authors apply the RIA framework to a recent programme for enhancing resilience implemented by the World Food Programme and the Government of Bangladesh. Béné et al. (2017) conclude with outlining conditions that should be considered for rigorous resilience impact evaluations in similar contexts. These entail the use of counterfactuals, internal validity, attention to social interaction threats (meaning the potential that treatments and behaviours are influenced by peers or those conducting the intervention), and the use of matching techniques.

Many of the existing frameworks for measuring resilience are too data-demanding, too academic or too time sensitive to meet practitioners' needs for rigorous monitoring and evaluating of resilience interventions…

Clare et al. (2017) use evidence from the fields of psychological resilience and wellbeing to assess the value of subjective resilience measures as a complementary approach to objective measures in standard resilience frameworks. They suggest that subjective approaches to measuring resilience may (1) improve the understanding of resilience drivers, (2) lower the burden on respondents that can be related to questionnaires in data-intensive standard resilience measurements, and (3) support more valid resilience comparisons across cultures. The authors caution that subjective approaches are in their early stages and much remains to be addressed before their wider adoption in the development and climate fields. This entails greater tailoring to these contexts, which are more event-specific than the original fields of application and may require back-casting and future projections from respondents.

To assess the linkages between socio-hydrological systems and resilience in the form of adaptive, absorptive and transformative capacities, Mao et al. (2017) propose a new framework made up of two parts. The first part is concerned with characteristics of socio-hydrological subsystems and systems (described in Figure 29) and their resilience to different hazards. The second step concerns resilience management. For this purpose, the authors introduce the 'resilience canvas', a tool to identify dynamic resilience pathways – most resilient, vulnerable,

susceptible and resistant – and design strategies to strengthen absorptive and adaptive capacities in human–water systems across different scales. Mao et al. (2017: 3665) conclude that the canvas can support ongoing transitions in water management strategies, including a move 'from the stage in "People with Water", through the "Water for People" stage, towards the "People and Water" stage', or the shift from resistant to resilient approaches.

Finally, Cumming and Peterson (2017) suggest a social-ecological framework to integrate both system collapse and resilience. Such a framework, the authors specify, requires (1) a well-defined system identity, (2) quantitative thresholds for system collapse, (3) linking processes of collapse to system structure, and (4) comparing alternative collapse models and hypotheses. Unlike more common approaches that focus on the impact of collapse on social-ecological systems and its properties, this framework aims to better understand the perturbations that bring about a collapse in the first place. The causes of collapse can be diverse and may lead to different types of collapse. This is evident in the 17 historical and contemporary cases of different types of system collapse presented in the article. From this analysis, the authors identify 14 mechanisms that may result in collapse and are linked to different structures for governing social-ecological systems, from flat to hierarchical and from individual to networked structures (Figure 30).

Figure 29. Three types of coupling human and water subsystems
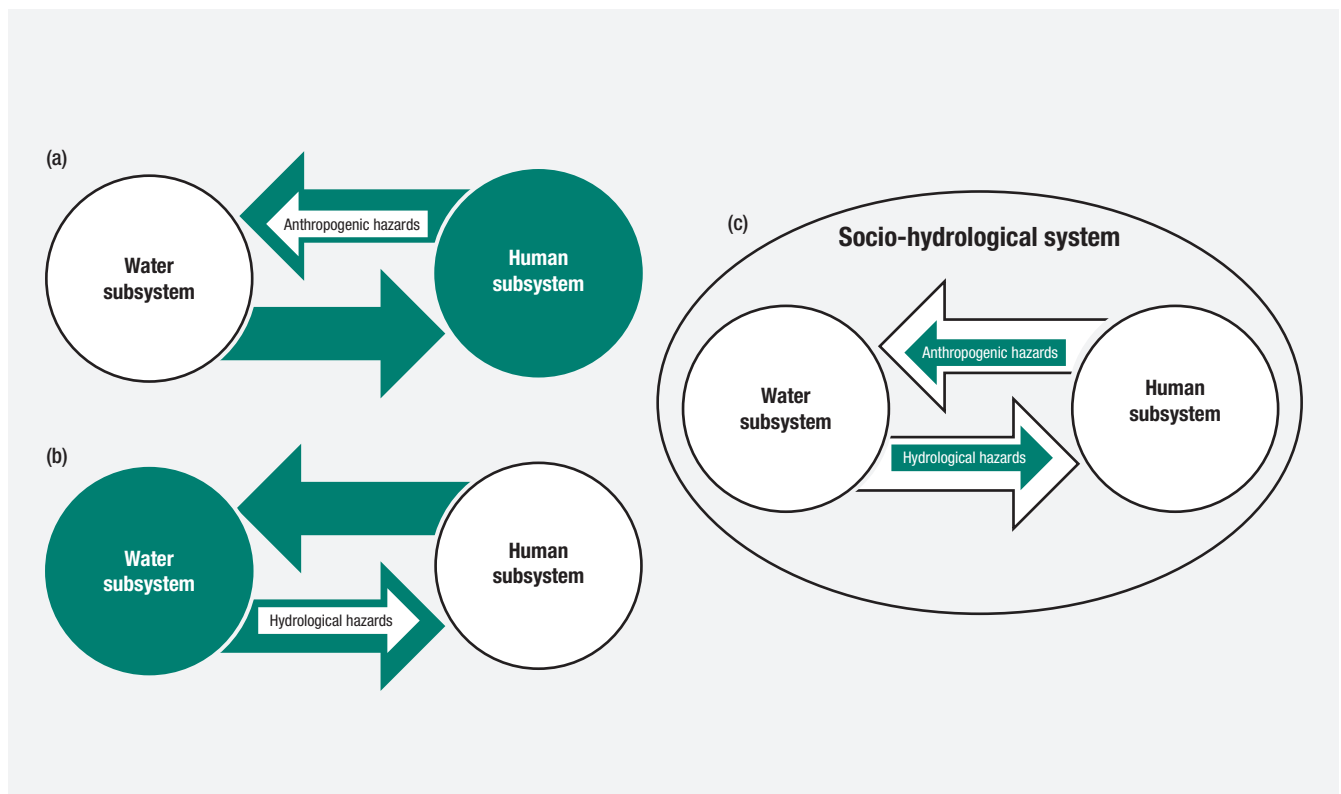
Source: Mao et al. (2017)

Figure 30. Proposed governance structure of social-ecological systems and related potential for different types of system collapse
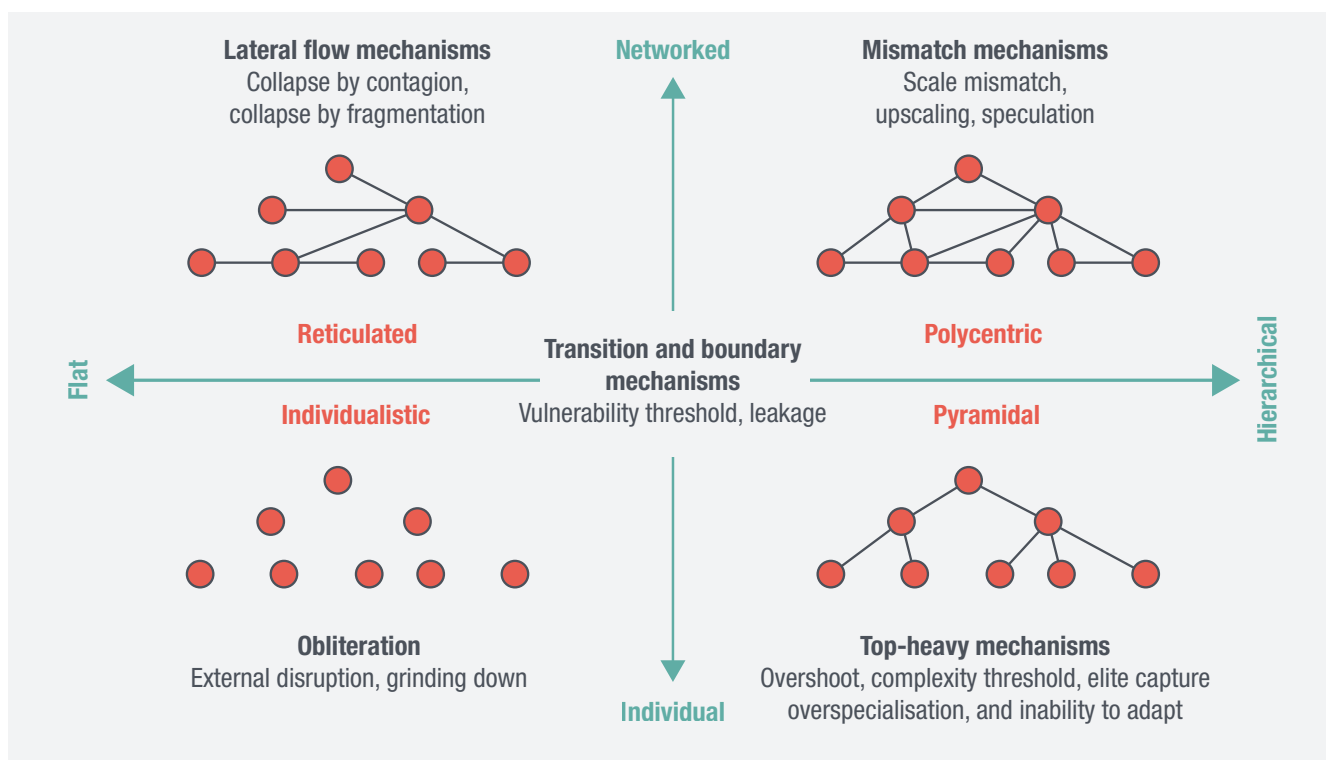
Source: Cumming and Peterson (2017)

4.3. Understanding impacts, policy and governance for resilience

Academic literature on understanding impacts, policy and governance for resilience suggests that:

- local knowledge needs to feed into national and sub-national policy frameworks and local preparedness plans to effectively support fishers' resilience
- though experiencing a disaster can increase one's level of preparedness, people with higher levels of formal education may be better prepared even in the absence of a disaster
- relationships between urban centres and their periphery, complex local agencies and the politicisation of local resources such as opium poppy and timber can play a reinforcing role at the intersection between climate change and conflict.

Two articles in this quarter's Resilience Scan focus on fundamental changes in coastal communities, including the acceleration of slow-onset impacts of climate change, an increasing frequency of extreme weather events, population growth and shifts in infrastructure and habitats. Goussard and Ducrocq (2017) argue that an evolution in spatial and conservation planning away from conventional engineering approaches is required in order to keep up with these dynamics and to better anticipate change. The authors

discuss a nexus-based approach to managing marine protected areas for enhancing resilience in this context. This, they argue, takes into account sectoral adaptation, cross-sectoral governance and territorial strategic planning to link land use and conservation planning through an inclusive process, reduce environmental impacts and lessen delays and conflict for developers in a way that takes the future into account.

Singh and Chudasama (2017) assess fishermen's perceptions of their level of preparedness to, and impacts from, extreme climatic events in eastern coastal districts in India. These impacts include economic losses and damages as well as social and ecological effects. Using fuzzy cognitive maps to capture perceptions and simulate pathways to preparedness, the authors find that none of the current preparedness measures of the studied communities are adequate to ensure their resilience against cyclones. To address this gap, the authors conclude that local knowledge needs to feed into national and sub-national policy frameworks and local preparedness plans.

In a context of generally low levels of disaster preparedness at household level, Hoffmann and Muttarak (2017) assess (1) whether and how formal education enhances preparedness, and (2) how prior experience of a disaster influences this relationship in the Philippines and in Thailand (Figure 31). While individuals who have previously been hit by a disaster are generally

Figure 31. The influence of education on disaster preparedness and its relationship with disaster experience
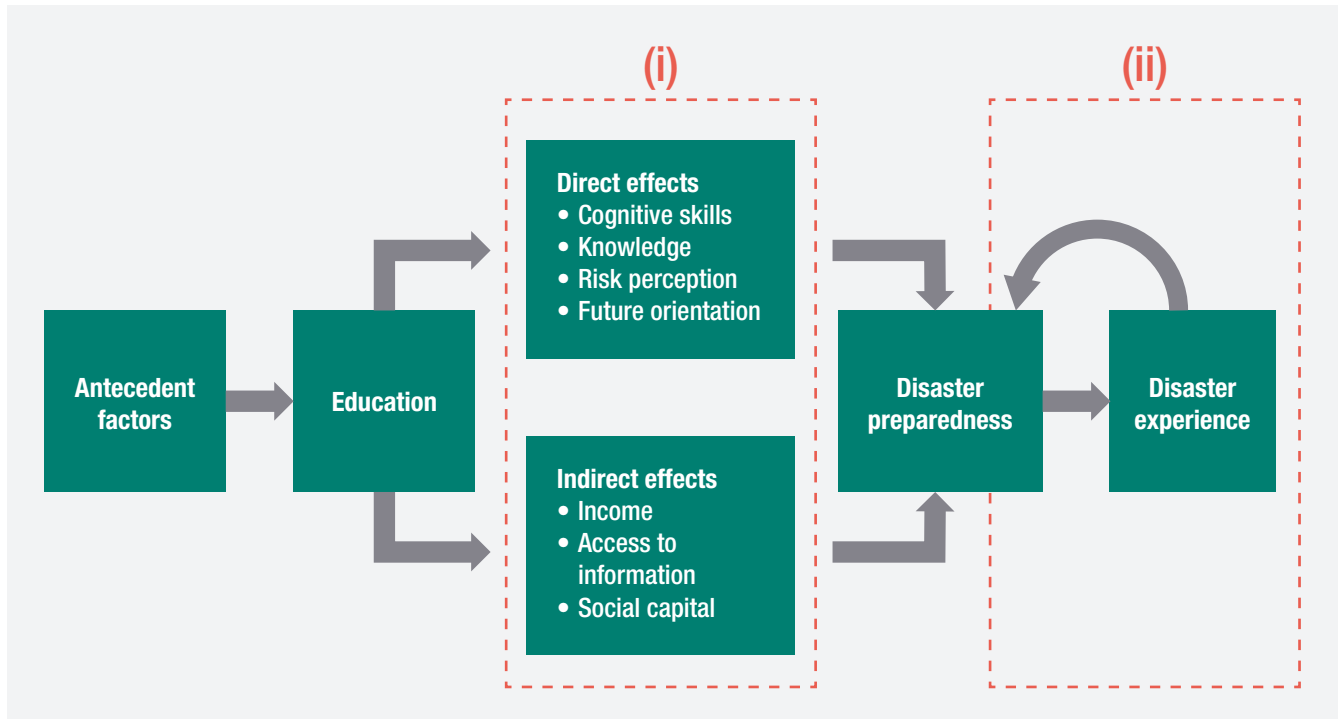
Source: Hoffmann and Muttarak (2017)

better prepared, the authors find that formal education increases the likelihood that individuals prepare without having been affected by a disaster first. In other words, people with formal education are better prepared even in the absence of a disaster. For the Philippines, education seems to be directly related to preparedness, whereas it is mainly mediated through indirect channels of disaster risk perception and social capital in Thailand.
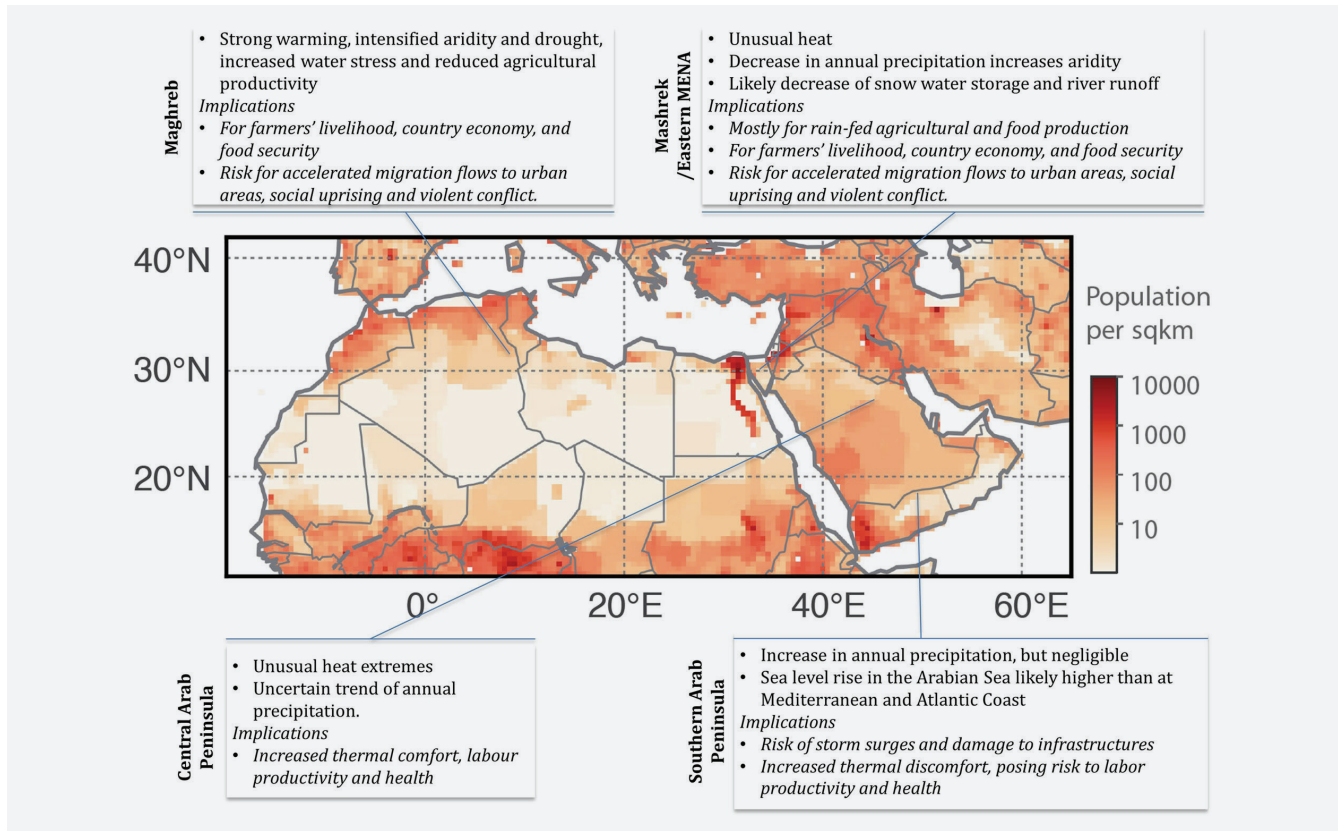
Also related to preparedness, Penadés et al. (2017) explore the links between approaches to resilient systems and the management of emergency plans at organisational level, for instance of governments or firms. The authors assess how an emergency plan can strengthen resilience in theory, but also highlight that this does not automatically translate into actual resilience. **In order to realise the resilience potential of an emergency plan, it must also be well managed.** To assess and support emergency plan management, the authors introduce an extended framework, which can be used by organisations to integrate resilience into emergency planning through a specifically developed tool.

Ingalls and Mansfield (2017) assess the interrelationship between social-ecological process and conflict in the eastern Afghan province of Nangarhar. In this context of complex geopolitical processes, the authors explore four inter-related causal pathways between social-ecological change and conflict: transitional resource governance; forest changes through trade and illegal logging; rangeland erosion through pastoral responses to conflict

and encroachment; and changes in agricultural land use through opium poppy cultivation. Drawing on a rich set of data, including satellite imagery, focus group discussions, interviews and field reports from different organisations, the authors underscore the relevance of relationships between urban centres and their periphery, complex local agencies and the politicisation of local resources such as opium poppy and timber.

The Middle East and Northern Africa (MENA) region is highly vulnerable to climate change, as it is characterised by biophysical impacts, sociopolitical pressures, a partial lack of resilience and an agricultural sector with a 70% share of rain-fed production (Waha et al., 2017). Building on a literature review and biophysical modelling, Waha et al. assess the impacts of climate change on a number of factors: temperature and heat extremes; precipitation, aridity and drought; SLR; agriculture and water; health; and human security and migration. The article outlines future scenarios for the region in a world which is 2°C and 4°C warmer. These are projected to reduce water discharge and increase heat extremes in parts of the land area. The authors conclude that this, in combination with other socioeconomic and political factors, would present unprecedented challenges to affected social systems. Societal responses to such changes are difficult to predict, but may include continuous migration flows to urban areas, increased dependency on agricultural imports and, therefore, more vulnerable food supply and further destabilising political environments (Figure 32).

Figure 32. Projection of impacts from 4°C global warming at the end of the 21st century across the MENA region

Maghreb
- Strong warming, intensified aridity and drought, increased water stress and reduced agricultural productivity
Implications
- *For farmers' livelihood, country economy, and food security*
- *Risk for accelerated migration flows to urban areas, social uprising and violent conflict.*

Mashrek /Eastern MENA
- Unusual heat
- Decrease in annual precipitation increases aridity
- Likely decrease of snow water storage and river runoff
Implications
- *Mostly for rain-fed agricultural and food production*
- *For farmers' livelihood, country economy, and food security*
- *Risk for accelerated migration flows to urban areas, social uprising and violent conflict.*

Central Arab Peninsula
- Unusual heat extremes
- Uncertain trend of annual precipitation.
Implications
- *Increased thermal comfort, labour productivity and health*

Southern Arab Peninsula
- Increase in annual precipitation, but negligible
- Sea level rise in the Arabian Sea likely higher than at Mediterranean and Atlantic Coast
Implications
- *Risk of storm surges and damage to infrastructures*
- *Increased thermal discomfort, posing risk to labor productivity and health*

Source: Waha et al. (2017)

4.4. Community resilience

Academic literature on community resilience suggests that:

- the effectiveness of conventional project management approaches in supporting communities' longer-term disaster resilience in reconstruction is limited, because they do not take prevention or preparedness into account
- urban resilience policies can favour physical infrastructure development, but need to consider other components such as sociopolitical relationships, values, norms and rules for reducing disaster risks and increasing resilience in informal settlements
- long-term outcomes from reconstruction projects were best when based on (1) an 'agile' project approach, (2) community trust, (3) a combination of technology, skilled labour and materials for hazard-safe housing, and (4) ongoing capacity-building within communities.

To study the relevance of local characteristics for resilience to tsunami hazards within coastal communities in Chile, Villagra et al. (2017) introduce the Coastal Community Resilience (CORE) model. Applying CORE to 14 coastal villages, the authors gather data on environmental, social and physical resilience components from municipality and government databases and on-site collection. They find that resilience variation between villages can be explained by

their indigenous, urban, rural and administrative-political properties. The CORE model, according to Villagra et al., provides a baseline for assessing community resilience and its determinants and presents entry points for local-level decision-making in coastal areas of Chile.

Urban informal settlements can be highly exposed to natural-hazard-related disasters. This is the case for the city of Mwanza in Tanzania, where people inhabit rocky hills, steep slopes and river valleys. Hambati and Yengoh (2017) use surveys, focus groups and spatial data to assess exposure and assess household and community activities to mitigate disaster impacts in these locations. They find that common hazards affecting communities in different areas in Mwanza include storms, landslides, floods and flash-floods, with some wards being prone to several of them. The authors conclude that existing urban policy-making for resilience measures tends to favour physical infrastructure development, but argue that other components such as sociopolitical relationships, values, norms and rules require greater recognition for reducing disaster risks and increasing urban resilience.

Pandey et al. (2017) assess the vulnerability of Himalayan communities to climate change using a climate vulnerability index. The environmental fragility and vulnerability of mountain ecosystems, according to the authors, present specific challenges in this context. The areas are sparsely populated and households mainly rely on agricultural

livelihoods. Exploring perceived reactions and counter-actions to climate change, the article further evaluates communities' potential to adapt through a current adaptive capacity index. This analysis builds on the five sustainable livelihood capitals – financial, human, natural, physical and social capital – and adaptive capacity, exposure and sensitivity as the three dimensions of vulnerability. The authors find that, in their study context, communities located further away from district headquarters showed greater levels of overall vulnerability compared to those closer to district headquarters. Some of this difference, according to Pandey et al., can be explained through differences in infrastructure and facilities between these two contexts.

In a context of increasing risks related to climatic variability, Patnaik and Das (2017) analyse whether development interventions in Western Odisha, India, also enhance coping and adaptation of the rural poor after a disaster strikes. Overall, results imply that the studied projects progressed towards their objectives measured as increased income, but benefits for participants are unequally distributed. The same applies to coping

and adaptive capacities, which were increased only in regions with good project performance or extensive project penetration. **To achieve more inclusive resilience outcomes,** the authors argue, **development projects can provide an important mechanism, but they should better incorporate DRR and management activities**.

Finally, Vahanvati and Mulligan (2017) critically assess conventional project management approaches often used for reconstruction after a disaster. The authors argue that the effectiveness of such approaches for supporting the longer-term disaster resilience of communities is limited, because they do not take prevention or preparedness into account. From four 'good practice' examples of reconstruction projects in India, the article concludes that long-term outcomes were best when the reconstruction was based on (1) an 'agile' project approach, (2) community trust, (3) a combination of technology, skilled labour and materials for hazard-safe housing, and (4) ongoing capacity-building within communities throughout and beyond the reconstruction phase. Their project model is presented in Figure 33.

Figure 33. A life-cycle model to support effective reconstruction of housing after a disaster
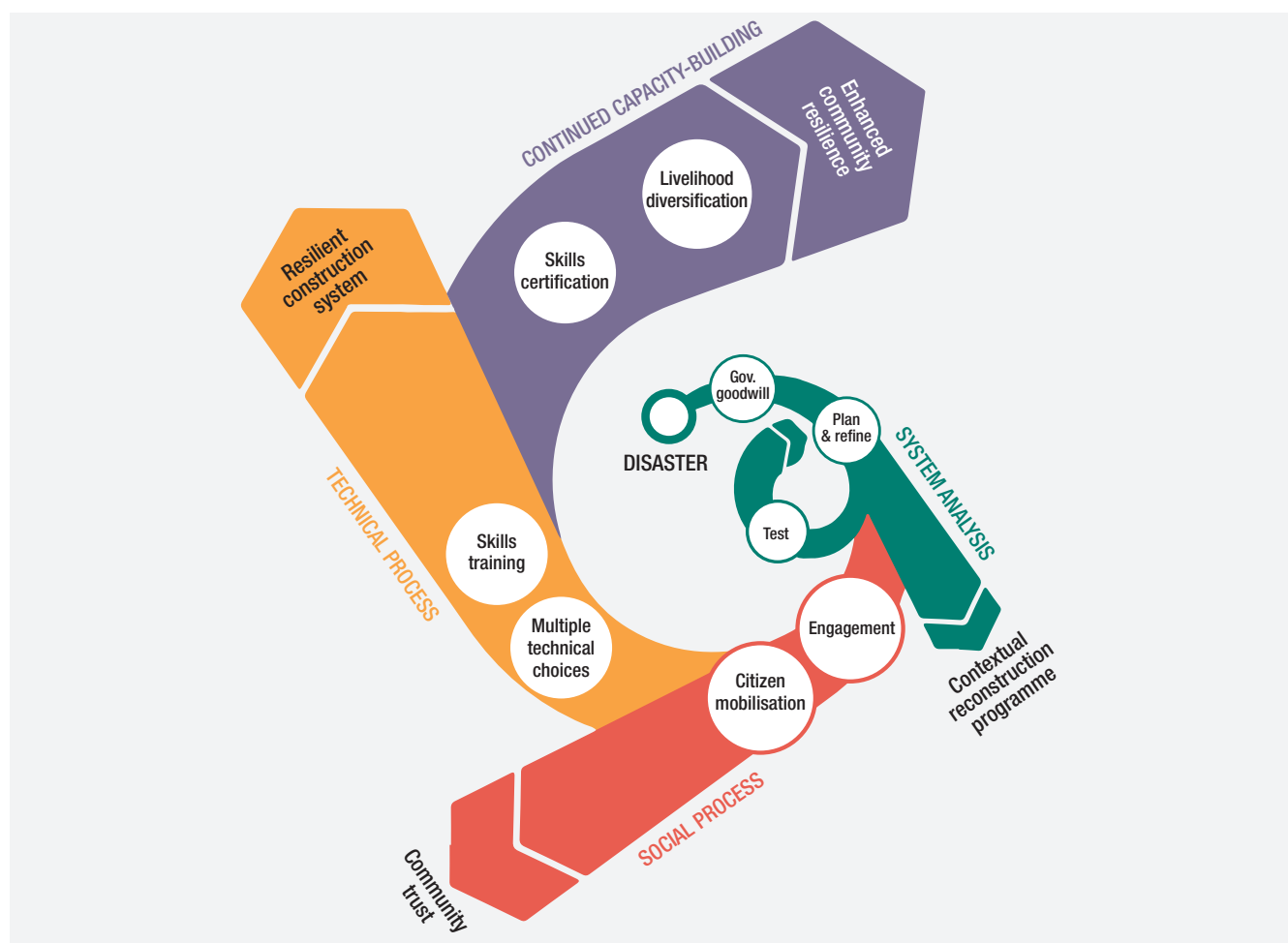
Source: Vahanvati and Mulligan (2017)

4.5. Health and resilience

Academic literature on health and resilience suggests that:

- investment in research that addresses health in relation to climate change has been comparatively lower than funding for research on climate change and its connections with other sectors such as agriculture
- droughts can have serious health impacts, but the difficulty of pinning down their exact starting point and their creeping onset and silent continuation mean that these effects are often not recognised or not attributed to droughts

With a total of three articles, the health theme features the lowest share of the academic literature in the third quarter of 2017. This group includes Ebi and Hess (2017), who trace the evolution of the climate change and health research field since the early 1990s. The authors show that investment in this area of research has been relatively low, and therefore has resulted in a smaller knowledge base compared to other sectors such as agriculture. To address the broadening research needs, the authors argue, vulnerability, capacity and adaptation assessments can support the prioritisation of gaps in research. Cross-sectoral engagement can help to protect and promote health.

Droughts can have serious health impacts, but the difficulty of pinning down their exact starting point and their creeping onset and silent continuation mean that these effects are often not recognised or not attributed to droughts (Sena et al., 2017). Brazil, in particular its semi-arid regions, is frequently impacted by droughts, which means that 'local governments and communities need easily obtainable tools to aid their decision-making process in managing risks, in particular health risks' (p. 4) in advance. Sena et al. (2017) aim to address this need through the development of relevant indicators for vulnerability, exposure and hazards to prioritise action for building resilience, reducing risks and preventing adverse impacts from droughts on health (Figure 34).

The vision of universal health coverage (UHC) has gained traction in the global health community, but non-linear and often fragile economic growth present a serious fiscal and political challenge to its implementation across the African continent (Russo et al., 2017). Russo and his fellow authors make the case for more attention to shock-resilient health systems and the need to take local contexts into account for the success of UHC. This includes, for instance, the recognition of non-linear patterns of economic growth and their implications for financing UHC, the prevalence and dangers of counterfeit drugs, or existing informal health providers who already deliver a large share of services and coexist with formal structures.

Figure 34. Reducing risks and facilitating community resilience
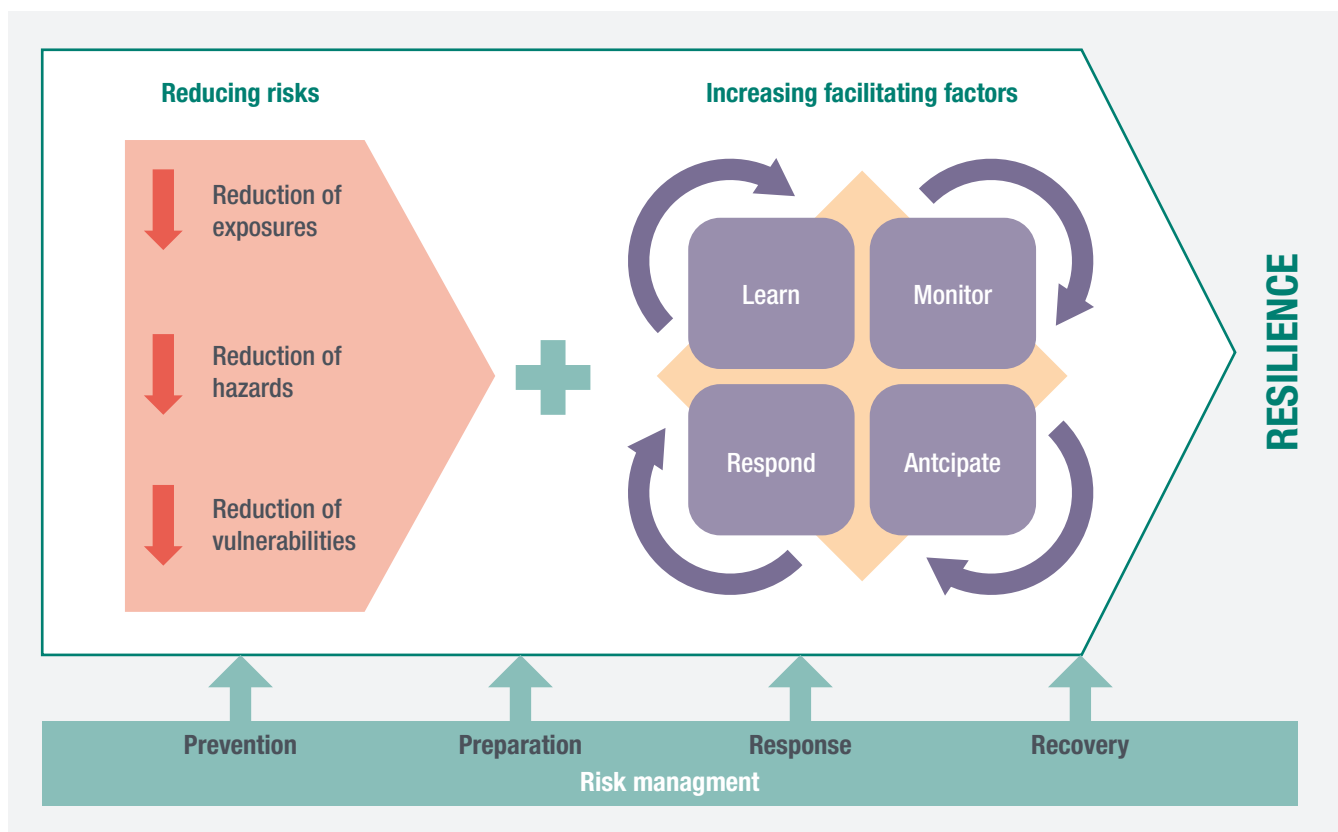
Source: Sena et al. (2017)

5. Understanding the characteristics of resilience in 2017 Q3 literature

This section interprets the grey and academic literature in the third quarter of 2017, 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:

- Access to climate information and forecasts is vital for raising awareness of imminent climate risks, but language barriers, technical barriers and lack of knowledge regarding how to apply this information undermines resilience.
- Greater awareness and comprehension of informal urban contexts are required to reduce misconceptions and to enhance DRR interventions for strengthening resilience in such contexts.
- Gaps in resilience awareness or knowledge among households and municipal decision-makers across different sectors present a central concern in the academic literature.

Two publications in the grey literature focus on people's awareness of the hazards they face. BRACED (2017a) highlights the experiences of people participating in 'listening groups' in Ethiopia, who, by accessing weather and climate information via the radio, can enhance their awareness and become better able to make informed decisions regarding planting and water conservation, for example. A lack of awareness of impending hazards, due to language barriers and ethnic segregation, was found to be a major factor increasing disaster risk for migrant communities in Thailand (Bravi et al., 2017).

Four studies focus on the government and other decision-makers' awareness of risks, vulnerabilities and risk management options. Jain et al. (2017b) stress the need for local and state governments (in India) to help communities and NGOs do preventative assessments before disasters strike in order to raise awareness of risks, vulnerabilities and risk reduction options. A working paper by Butterfield et al. (2017) stresses the importance of raising awareness of the benefits of protecting natural resources and ecosystems. The World Bank (2017) published a practitioner's guide for prioritising climate-resilient transport investments, providing a process to enhance awareness of resilience factors. Finally, a UNISDR and IDMC (2017) report provides a baseline for the scale, scope and distribution of risk associated with sudden-onset hazards in the Greater Horn of Africa.

Three of the academic articles in this quarter focus on gaps in resilience research or introduce methodologies to better understand and assess resilience (Béné et al., 2017; Clare et al., 2017; Ebi and Hess, 2017). Ebi and Hess (2017) argue that many key research gaps remain in the climate change and health field, and new themes and questions are emerging, for example around mental health, occupational health or migration. Subjective approaches have gained traction, subjective in the topic of the question itself (for instance when it refers to an inherently subjective theme such as happiness), as well as a focus on capturing personal opinions, perceptions and evaluations of a topic (Clare et al., 2017). These subjective approaches have the potential to increase the understanding of what drives resilience and how to compare across cultures in a valid way. To support a better understanding of what works for interventions aiming to strengthen resilience, Béné et al. (2017) suggest a new RIA framework. Their approach satisfies the need of many practitioners to implement rigorous monitoring and evaluation while being confronted with operational challenges and constrained resources.

Four additional studies outline resilience awareness or knowledge gaps among households and municipal

decision-makers across different sectors. Measuring drought-related health risks in Brazil, Sena et al. (2017) underscore the importance of better understanding local vulnerabilities, hazards and exposure in order to inform municipality decision-making. In Thailand and the Philippines, Hoffmann and Muttarak (2017) show that previous experience of a disaster positively influences a household's disaster preparedness. Greater awareness and comprehension of disasters in informal urban settlements in Tanzania are required to reduce misconceptions and enhance DRR interventions in such contexts (Hambati and Yengoh, 2017). Studying the resilience of ecotourism to climate change in the Jordanian Dana Biosphere Reserve, Jamaliah and Powell (2017) highlight the multidimensional nature of the resilience concept, including economic, environment, governance and social components.

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:

- Market systems development can open up diverse livelihood and market opportunities, thereby enhancing resilience.
- The involvement of a diverse group of stakeholders in decision-making is necessary to minimise negative impacts and maximise co-benefits in other sectors, particularly in areas of conflicting interests and policies.
- Though diversification presents a major opportunity to increase the resilience of livelihoods, climate change can also reduce the availability of diversification options.

Diversity was not a major theme in the resilience literature this quarter. Two publications in the grey literature highlight the need to integrate a diverse range of stakeholders in decision-making (Hurford et al., 2017; Butterfield et al., 2017). In addition, Mercy Corps (2017b) shows that market systems development can open up diverse livelihood and market opportunities, and foster changes that can enhance the development of households.

As in previous Resilience Scans, crop and livelihood diversification as a means for strengthening resilience is represented in this quarter's academic literature. This includes Nordhagen et al. (2017), who assess what influences farmers in their decision to diversify crops in Papua New Guinea. Though diversification presents a major opportunity to increase the resilience of livelihoods, climate change can also reduce the availability of options, as Savo

et al. (2017) show in the case of subsistence coastal fishing communities across the globe. Assessing the resilience of coastal communities in Chile, Villagra et al. (2017) highlight the differences and similarities of these communities' rural, urban, indigenous and political characteristics and how this relates to diverse patterns of resilience. Therefore, the authors argue, hierarchical decision-making around community resilience can be problematic.

5.3.   Self-regulation

Self-regulation 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:

- City governments can take action to tackle climate risk and climate change even without significant support from national-level policy, with leadership and creativity.
- Health systems need to be adjusted to resource-scarce contexts and be able to cope with and learn from shocks for their reorganisation if they are to become more resilient and support UHC in African countries.
- To ensure post-disaster reconstruction supports longer-term community resilience, standard project management cycles need to be expanded by prevention and preparedness activities.

Self-regulation was not a major theme in the grey literature in this quarter. Nevertheless, a policy brief from the Centre for Policy Research in India stresses that, with leadership and creativity, city governments can take climate action even where this is not mandated or encouraged by state and national policy (Bhardwaj and Khosla, 2017). Kumar et al. (2017) highlight the potential role of wetlands to support systems to self-regulate, as part of eco-DRR approaches to DRM.

In the academic literature, self-regulation was a larger focus as compared to previous Scans. This includes self-regulation at household level, with Smith and Frankenberger (2017) analysing the relevance of resilience capacities on households' ability to maintain their food security in the face of a shock. Results indicate that different capacities indeed play an important role for mitigating flood impacts in northern Bangladesh, with evidence as to households' absorptive capacities being the most robust. At project level, Vahanvati and Mulligan (2017) argue that to ensure post-disaster reconstruction supports longer-term community resilience, standard project management cycles need to be expanded by prevention and preparedness activities.

Three publications address self-regulation at systems level. Cumming and Peterson (2017) define four criteria that must be met for defining collapse of a social-ecological system: (1) identity of the system is lost, (2) identity loss happens fast, (3) substantial social-ecological capital is lost, and (4) consequences of the collapse are lasting. The authors understand resilience as two sides of one coin, meaning 'collapse occurs when resilience is lost, and resilient systems are less likely to collapse' (p. 696). Assessing characteristics and options for enhancing the resilience of human–water systems, Mao et al. (2017) introduce a novel framework and tools to facilitate a better understanding of how these systems cope with and respond to distress. The difficulty of realising UHC in African countries with volatile markets, Russo et al. (2017) argue, requires more resilient health systems in the sense that they need to be adjusted to resource-scarce contexts and be able to cope with and learn from shocks for their reorganisation.

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:

- A 'one UN' approach that integrates the DRM and conflict agendas is needed to implement the overlapping prevention and sustaining peace agendas.
- Migrants, particularly those who are not well integrated into society, face greater climate risk as they are less able to access climate forecasts, warnings and other information.
- Integrating the concept of resilience within the assessment and management of emergency planning can help to strengthen emergency preparedness.
- To strengthen the resilience of food security, ecological approaches need better integration with socioeconomic considerations, to support a holistic approach across multiple scales.

Several publications in the grey literature focus on integration of different voices in decision-making processes, overlapping with the 'diversity' section above. Bhardwaj and Khosla (2017) highlight that enabling climate action in Indian cities is a collaborative exercise, and strategic planning requires linkages and integration across sectors to deliver across multiple objectives. Nguyen and Tyler

(2017) outline an approach to urban riverbank erosion management that integrates communities from both sides of a river within decision-making and implementation, and which successfully leveraged participation and finance from these local stakeholders to support the project. Fraser and Kirbyshire (2017) stress the importance of investing time and creating space to integrate and engage stakeholders in governance arrangements designed to enhance resilience, recognising realities of political institutions.

Two publications consider international integration of agendas and resilience efforts. A report by Stein and Walch (2017) stresses that implementing a prevention and sustaining peace agenda requires a 'one UN' approach. Delivering this goal needs the integration of disasters and conflict agendas, and the breaking of institutional silos, given the overlap between their respective drivers. Babu and Dorosh (2017) stress that famine prevention and drought responses should extend beyond country borders.

In addition, a Mercy Corps (2017a) report recommends that disaster analysis and preparedness should be integrated within development programmes to work towards local resilience. Limited integration into Thai society was found to be a major risk factor for migrant communities in Thailand, and there is a need for disaster management plans to specifically target the most vulnerable groups such as undocumented migrant workers (Bravi et al., 2017).

Academic literature under this theme revolves around the need for integration in resilience assessments, policy-making, planning and interventions. For instance, Kenny (2017) concludes modelling processes for climate-resilient agriculture should be based on integration, participation, spatial explicitness and systems thinking. Goussard and Ducrocq (2017) highlight the dynamic nature of marine and coastal areas in the context of climate change and argue for a greater integration of strategies, including society-, ecosystem- and engineering-based approaches, to support coastal adaptation.

Through aims such as poverty reduction, income generation or livelihood diversification, development projects may provide tacit co-benefits for strengthening resilience. To ensure that they realise this mutually inclusive potential, Patnaik and Das (2017) argue that projects need to integrate DRM and resilience components within their underlying frameworks. Penadés et al. (2017) integrate the concept of resilience within the assessment and management of emergency planning. Finally, in order to strengthen the resilience of food security, ecological approaches need to be better integrated with social and economic considerations into a holistic approach covering multiple scales (Bullock et al., 2017).

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 it, 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:

- Flexible funding is needed to enable adaptive programming.
- Emergency cash transfers, and especially cash-for-work programmes, can help to enhance women's adaptive capacity following a disaster, by supporting their economic empowerment.
- Strengthening the resilience of smallholders can help them to grapple with climate change, but decidedly reducing hunger also requires structural transformation of food systems.
- The adaptation of social-ecological systems to continuous conflict can, in turn, shape or intensify the dynamics of the conflict.

Several publications in the grey literature assess adaptive strategies for dealing with climate risk and climate change, while others focus on adaptive capacity and adaptive programming. A CIAT working paper (Ng'ang'a et al., 2017) finds that adapting agricultural practices to be more climate-smart can achieve positive results in terms of cost-benefit analysis. An IFPRI Discussion Paper (Nkengia-Asi et al., 2017) outlines the different adaptive strategies employed by men and women for coping with climatic change. Wekesa et al. (2017) document adaptive livelihood strategies employed by smallholder farmers in Kenya. For urban areas, 100RC (2017) documents a host of adaptive plans and measures taken by cities around the world to adapt to climate risks. Nesbitt-Ahmed (2017) indicates that emergency cash transfers and cash-for-work programmes can help to enhance women's adaptive capacity by supporting their economic empowerment, while a Mercy Corps (2017a) report highlights the need for flexible funding for programmes to adapt to rapidly changing contexts and maintain relevance to local needs.

Adaptiveness is the key theme in most of this quarter's academic literature. To grapple with recurrent food crises in Ethiopia, Lewis (2017) argues that although strengthening disaster response, early warning and the resilience of smallholders may support food security, climate-sensitive livelihoods and smallholder farming structures need to be addressed as the major underlying causes of food insecurity. Similarly, fishing communities in India's eastern Ganjam and Puri coastal districts are highly vulnerable to cyclones, but Singh and Chudasama (2017) find that their levels of preparedness are insufficient to support resilience in a context of rising climate-related shocks and stresses.

Concerning adaptive capacity and adaptation strategies at household or community level, Biffis and Chavez (2017) show how adapting agricultural practices in a way that reduces exposure to rainfall variability, for instance through investing in irrigation infrastructure or using different varieties of crops and other inputs, can result in economic benefits in the form of reduced costs for insurance. Modelling the implications of different farming intervention under a changing future climate, Moat et al. (2017) show how the adaptation of growing practices and a shift towards new areas might increase, rather than eliminate, the potential for coffee production in Ethiopia.

Webb et al. (2017) underscore the need to consider how land degradation interacts with climate change. In the Himalayan mountains, Pandey et al. (2017) explore communities' capability to adapt to climate change based on their vulnerability and response mechanisms. Exploring the interconnections between resilience and conflict, Ingalls and Mansfield (2017) highlight how the adaptation of social-ecological systems to continuous conflict can, in turn, shape or intensify the dynamics of the conflict in Afghanistan. Waha et al. (2017) explore the immense challenges related to global warming in the MENA region.

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Resilience: rising to the challenge in coastal regions

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