# Resilience scan | July - September 2015

A review of articles, reports, debates and social media activity on resilience in international development

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REPORT

The quarterly resilience scans are complemented by 'deep-dive' analytical papers that focus on emergent aspects of resilience thinking and practice. To date we have published deep-dives focus on measurement of resilience, assessing perceived or 'subjective' resilience, and on psychological resilience.

Please see www.odi.org/resilience-scan for details of these papers and previous resilience scans.

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Abstract

This 'resilience scan' summarises writing and debates in the field of resilience during the third quarter of 2015, focussing primarily on the context of developing countries. The scan will be of particular interest to those implementing resilience projects and policies and those seeking summaries of current debates in resilience thinking. It comprises insights from the workshop on Resilience: Tools, Measurement & Application convened by USAID/RDMA in partnership with the Rockefeller Foundation in Bangkok from 14th-15th October 2015, Twitter conversations on resilience, grey literature and academic journal articles. The final chapter synthesises the insights from literature in terms of Rockefeller Foundation's 5 characteristics of resilience- awareness, diversity, self-regulation, integration and adaptiveness.

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Executive summary

This 'resilience scan' summarises writing and debates in the field of resilience during the third quarter (July- September) of 2015, focussing primarily on the context of developing countries. The scan will be of particular interest to those implementing resilience projects and policies and those seeking summaries of current debates in resilience thinking.

The section on insights from resilience experts this quarter is a thematic summary drawn from the author's insights during an international workshop on *Resilience: Tools, Measurement & Application* convened by USAID/RDMA in partnership with the Rockefeller Foundation in Bangkok in October 2015. We highlight:

- The importance of understanding and managing trade-offs in resilience building. These tradeoffs can relate to individuals and groups, to geographical or temporal scales, to structure and function, and between different types of hazard.
- The need to focus more attention on measuring the chronic stressors that affect large sections of the population on a frequent basis, as well as resilience to compound shocks and stresses rather than taking a hazard by hazard approach.
- A range of different approaches to measuring resilience were presented, highlighting in particular the distinction between those tracking number affected or losses, and those seeking to measure the characteristics of ex ante resilience.

- Links were made to the emerging resilience components within the set of 2015 platforms/ frameworks, with calls to ensure that measurement approaches are joined up to prevent duplication.

The analysis of resilience influencers, networks and topics on Twitter revealed that as compared to the last Twitter analysis in the Resilience Scan for Jan-March 2015:

- Climate resilience still has the most prominent discursive visibility among the seven sectors analysed, followed by conflict and water resilience. Economic resilience is the least discussed sector.
- In terms of cross-cutting themes, women and gender issues feature more prominently in tweets on resilience as compared to the last scan, as do issues relevant to local responses and cases studies, especially in the context of climate resilience.
- Discussions on disaster risk enjoy less visibility, which was dominated by the build up to the Sendai World Conference on DRR.
- The most vocal and influential voices discussing resilience on Twitter continue to be expert organisations, NGOs and donors. As evident from the network diagrams, the nodes closer to the centre are almost all expert/institutional accounts.
- Broadcasting links continue to dominate, rather than discussion streams, and networking with potentially relevant conversational circles is limited.

Insights from the grey literature in the quarter July-September 2015 are summarised by thematic topic below.

Grey literature on monitoring and evaluation suggests:

- To measure changes in resilience, collecting data at a high frequency is necessary.
- The complex systems that impact individual resilience can best be measured using multiple assessment techniques simultaneously.
- Theoretical resilience frameworks are often mismatched with the general development-oriented indicators used to track resilience outcomes.
- Conceptualising resilience as a set of anticipatory, absorptive and adaptive capacities is flexible enough to evaluate resilience outcomes across a variety of contexts and interventions.

Grey literature on subjective resilience suggests:

- Objective indicators do not capture information about attitudes, perceptions, judgements, social networks, preferences and self-assessments – all of which inform research about how households cope with shocks and stresses.
- Qualitative information on resilience complements objective indicators and can shape the design of quantitative M&E instruments.

Grey literature on social protection and resilience suggests:

- Social protection, climate change adaptation, and disaster risk reduction share a common goal of supporting resilience for the most vulnerable.
- Integrating social protection into disaster management policies can improve early recovery and support resilient livelihoods.

Grey literature on policy, planning and resilience suggests:

- Integrating vulnerability assessments into municipal policy requires involving the right political actors and engaging them in a continuous process of resilience planning.
- Climate Action Plans must be coordinated with regular planning and budgeting mechanisms in government agencies.
- Recommendations from vulnerability assessments or Climate Action Plans should be allocated additional funding in order to avoid being a stand-alone exercise.

Grey literature on climate-smart agriculture and resilience suggests:

- 'Climate-smart agriculture' is not clearly defined, leaving room for diverse visions of what the concept means in practice.
- Not all climate-smart agriculture projects are grounded in decades of practice in sustainable agricultural development.
- Existing climate-smart agriculture policy is weak on gender inclusion and lacks clear commitments to agroecological farming methods.
- Attempts to mainstream gender into climate-smart agriculture programmes should be designed to tackle the institutional arrangements that allocate different decision-making benefits to men and women.

Insights from the peer reviewed literature in the quarter July-September 2015 are summarised by thematic topic below.

Papers on politics and governance suggest:

- Using political-economy approaches to understand resilience-building policy processes allows us to take into account the different socio-economic and political factors that marginalise or exclude certain people, whilst making others privileged and elite.
- An integrated approach for governing disaster risk and resilience is necessary to manage the interdependencies that exist within a system.
- Using adaptive and multi-level governance can help deal with the complexities of climate change and the dynamics of social-ecological systems.
- Multi-stakeholder engagement across scales from the local to national to supranational is essential for disaster management to be effective and to help build resilience at all levels and across sectors.

Papers that engage with themes of urban resilience suggest:

- Physical resilience through the provision of reliable and effective infrastructure and technology can help increase resilience at all levels, from local to national, and from rural to urban settings.
- Urban infrastructure and technology operate as part of an overall system in which interdependencies exist, which can lead to cascading infrastructure failures if they are not addressed in an integrated way.
- The functioning of a system and its ability to self-regulate or bounce back after a shock is important to assess the subsequent socio-economic impacts and the resilience of the system as a whole.

Papers that engage with themes of agriculture and livelihoods suggest:

- Climate change and natural hazards impact agroecological systems differently, and therefore a variety of context specific adaptation strategies and policies are needed to build the resilience of agricultural practices.
- Climate-smart agriculture, technology and innovation are all key to building the adaptive capacity and resilience of farmers and social-ecological systems that support agricultural practices.
- An integrated approach is needed across scales and sectors to build the adaptive capacity and resilience of the food system and food chain (from the production, distribution and consumption of produce and goods).
- Analysing past and current coping strategies and the adaptive capacity of different communities to natural hazards can help practitioners and policy-makers consider the drivers of change and how these have contributed to livelihood resilience and a community's ability to cope with and respond to such an event.

Papers that present insights on framing and measuring resilience suggest:

- The term 'transformation' is useful as an analytical concept if it is used in a robust and rigorous way, but it is important to 'resist the fashion of transformation, i.e., the temptation of attributing a transformative character to any instance of social change' (Feola, 2014: 387).
- Measuring resilience, vulnerability and adaptive capacity is essential in order to understand the coping and adaptation strategies of different individuals and communities and the functioning and return time of different systems after a disaster.
- It is possible to identify patterns and compare places that have similar vulnerabilities in order to help connect communities and to enhance networking, learning and cooperation in building resilience.

A final section of the scan reflects on connections across the growing field of resilience to understand the directions in which the field is moving. It highlights **lessons and reflections from the scanned literature based on five characteristics of resilient systems** listed below:

Awareness:

- The use of robust data, monitoring and evaluation is key for raising awareness and building a greater understanding of what strengths, weaknesses and risks exist within a given context and therefore what is needed to help build resilience to natural hazards and disasters.
- Collecting resilience information at a high frequency is key for improving situational awareness, which requires data from both big data streams and smaller, crowd-sourced data or surveys.
- Community and public awareness about different risks and threats is essential for informing adaptation planning and building resilience.

Diversity:

- Collecting information from a wide range of diverse sources is emphasised heavily in the grey literature on monitoring and evaluation.
- The diverse nature and characteristics of different systems and ecosystems need to directly inform policy and decision-making processes.
- Diversity is implicit in the range of skills and capacities that people can use to prepare for and respond to disasters.

Self-regulation:

- The different stages that take place in the process of self-regulation are referred to using the terms tipping-points, change in state, resistance and recovery time within the peer-reviewed journal literature.
- The possibility of cascading disruptions due to interdependencies within a system, demonstrating a lack of self-regulation, is discussed in the peer-reviewed journal literature.
- Social protection programmes feature as a mechanism to support self-regulation for the poorest, though self-regulation is addressed only implicitly in the grey literature.

Integration:

- Integration is meaningless without 'shared information' being taken up in policy and accounted for in budgets.
- Horizontal and vertical integration between individuals, groups and organisations, as well as across sectors and scales is essential for building resilience to climate extremes and disasters.
- Collaborative communication and the use of integrated knowledge can help facilitate greater effectiveness and co-ownership of tools, practices and policies and better ways of working.

Adaptiveness:

- 'Adaptiveness' is not mentioned explicitly in the grey literature, aside from a new M&E framework that defines 'resilience-related capacities' – anticipatory, absorptive, and adaptive.
- Adaptive capacity is a prominent theme within the peer-reviewed journal literature, which assesses the adaptive capacity of communities, ecosystems and urban systems.
- Social cohesion and family/social networks make a strong contribution to adaptive capacity.
- Adaptive governance is important for managing the diversity and complexity of social-ecological systems.

1. Expert Views from the Bangkok Resilience Workshop

The expert view section in this scan is a summary of key issues and debates from the workshop on *Resilience: Tools, Measurement & Application* convened by USAID/RDMA in partnership with the Rockefeller Foundation in Bangkok from 14th-15th October. This workshop brought together roughly 100 resilience practitioners and technical experts to share experience on the application of resilience principles and approaches to measurement. A wide variety of organisations participated in presentations and discussions, from which we have distilled a number of cross cutting themes that reflect challenges and developments in the field of resilience thinking and practice. The full set of resources from the meeting are available at https://sites.google.com/site/resilienceworkshop/home.

1. Managing trade-offs and interdependencies

An important theme that emerged from the various discussions was about understanding and gauging 'trade-offs' in building resilience. At least five types of trade-offs were discussed in various parts of the meeting (either explicitly or implicitly).

- First, there are trade-offs **at the individual level** in enhancing resilience. This means that enhancing resilience for one person or group could result in reduced resilience for another group. For instance, helping a families in one community deal with flooding by building walls around their homesteads could result in the enhanced inundation of communities living downstream.
- Second, there are trade-offs **in geographic scales**, where enhancing resilience at one scale of governance could result in enhanced vulnerability at another. For instance, diverting economic resources to build resilience in particular cities could come at the cost of reduced funding for resilience at the provincial level.
- Third, there are trade-offs between **time scales**. This could mean that investing in risk reduction and resilience now, say through the installation of

protective infrastructure, could result in increased vulnerability at a later date by encouraging human settlement and concentration of assets in areas that ultimately may be more vulnerable due to changing climate impacts. Investment in resilience now may also trade-off through the opportunity costs of other foregone investments.
- Fourth, there could be trade-offs in **structure and function**. For example, a country may have an electricity supply system that is resilient to shocks and stresses but that is reliant on fossil fuels that ultimately exacerbate climate change and contributes to increased natural hazards.
- Fifth, there could also be trade-offs in enhancing resilience to **particular types of hazards**. For example, enhancing the resilience to the impact of earthquakes through the use of light building materials may erode their ability to function through hurricanes. Also, in some cases the very factors that build resilience to natural disasters (e.g. social networks) may erode resilience to other hazards (e.g. Ebola that spreads through human contact).

The workshop discussed insights into these trade-offs and how approaches to measuring and operationalising resilience need to be geared to also understand and track such trade-offs and side effects of enhancing resilience.

2. Tracking extensive risk, compound stressors and thresholds

Another recurrent theme of the meeting was the importance of considering extensive risk and compound stressors when building resilience. There was wide acknowledgement that much of the debate on resilience is focussed on intensive risks from major shocks. A number of participants noted that the media, governments and even individuals are only mobilised to take action during big disaster events. As a result, the discourse on enhancing resilience has an implicit bias towards these large rapid onset disturbances. There was consensus on the urgent need to correct this imbalance as the lives and

livelihoods of marginalised communities across the world are disrupted far more frequently by **events that are low in intensity but high in frequency** (e.g. chronic health risks, air pollution, waterlogging or low level flooding). This type of 'extensive' risk receives little attention as in many cases it is considered as 'normal' conditions. Its impacts are therefore not frequently accounted for in loss and damage assessment that normally take place after big disasters as a precursor to the provision of relief. Integrating extensive risk will require more frequent monitoring to pick up these signals.

A related discussion centred on the inadequacy of the current array of tools and approaches to tackle and measure **resilience to compound stressors**. Experts at the meeting acknowledged the tendency to focus on individual hazards in isolation, illustrated by the specificity of many tools and resilience approaches to 'flooding', 'earthquakes', or 'security threats'. However, this may ignore the influence of multiple and combining threats on the nature of the impact and the most appropriate response. Apart from inter-related effects of different hazards, the influence of major shifts such as rapid urbanisation, environmental degradation and migration in influencing the impacts of compound shocks and stresses that vulnerable communities face. To be successful, approaches to enhancing resilience must incorporate an understanding of these dynamics and their complexity.

The meeting also included an interesting discussion on **resilience thresholds** at which people were able to withstand a given basket of threats and still survive and thrive. A presentation from a representative of ODI's Chronic Poverty Advisory Network demonstrated the network's research on defining 'resilience to poverty lines' as income levels at which there is a significantly reduced risk of non-poor people being dragged into poverty. This helped shed light on how to make wider progress on understanding thresholds to diverse shocks and stresses.

3. The measurement debate: costs, characteristics, capacities and impacts

The state of knowledge on measuring resilience is evolving rapidly, but we distilled five major pathways to approaching the question of measurement.

- First, there are a growing number of approaches that aim to understand the costs and benefits of enhancing resilience. This is moving beyond interest in only the value of resilience building measures for avoiding losses when shocks and stresses occur to also include ways of gauging a 'resilience dividend', including co-benefits of resilience building, both intentional and unintentional. Crucially, these can be generated even when shocks and stresses are not present, so their benefits are more certain than

avoided losses. While there are a small number of emerging empirical examples on how this dividend could be harnessed, a wider base of evidence is needed to support such arguments. For example, the Rockefeller Foundation highlighted 'Resilience Value Realization' efforts to build shared stakeholder understanding of these values in order to secure action and investment in resilience throughout the project implementation cycle.

- Second, some approaches are focussed on tracking hazard impacts as a proxy to measuring resilience. These usually focus on considering improvements in resilience based either on the number of people affected by hazard events or by the damage caused to immovable property. The most pertinent example is in Sustainable Development Goal 1.5 that reads: 'By 2030 build the resilience of the poor and those in vulnerable situations, and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters'. The current proposed priority indicator for target 1.5 is the number of people affected by hazardous events, disaggregated by age and sex. While this is an important indicator to measure the impact of shocks and disasters, it clearly does not address resilience building and vulnerability reduction. Another set of approaches within this group focus on gauging resilience by 'modelling potential loss'. These model future risks and hazards on the system, group or area of interest and attempt to quantify the potential losses if a shock or stress were to occur. These approaches are common to catastrophic risk modelling in the insurance industry.

- Third, a growing number of approaches to measuring resilience, led by those stemming from the food security domain (and the Food Security Information Network in particular), propose 3 main components to accurately gauge resilience:
  a. measure changes in capacities of resilience (adaptive, absorptive and transformative capacity) of a system (e.g. of a community), and
  b. changes in wellbeing (e.g. health, nutrition or education outcomes), while
  c. tracking and normalizing results for shocks and stresses.

If a community's capacities and wellbeing are increasing in spite of shocks and stresses, then they are becoming more resilient. In some circumstances, the resilience of a community may also increase, despite a dip in development outcomes, if the frequency or intensity of shocks and stresses has also increased with reference to a baseline. While there is a growing consensus that this represents one useful approach to measuring resilience, there are gaps in knowledge on methodologies of preparing baselines

for shocks and stresses that appropriate outlier events adequately. Also, there needs to be greater emphasis on understanding negative coping strategies that may result in temporary spikes in wellbeing but may erode long term resilience.

- Fourth, some approaches measure latent/ex-ante resilience capacity through gauging the degree to which systems (e.g. communities, cities etc.) have a certain characteristics. These characteristics are primarily qualitative and include issues such as redundancy, flexibility, modularity, integration. Some approaches couple these characteristics with other attributes that a system must possess to be resilient such as leadership, social capital, security etc. The ARUP-Rockefeller Foundation City Resilience Framework provides a good example of such an approach.

- Finally, the importance of collecting data on individual perceptions, or 'subjective resilience' was frequently expressed. This encapsulates the idea that vulnerable population have a very different understanding risk and resilience as compared to experts, governments or developmental agencies. Experts discussed how the latter have traditionally been concerned with intensive, large scale shocks, but in many cases the former consider stresses and sources of extensive risk to be far more influential in undermining their wellbeing and resilience. Overall, there was a call to ensure that these subjective perceptions must be accommodated in any approach to measure or enhance resilience and could be garnered through new technologies (e.g.crowdsourcing information using cell phones).

4. Policy impetus for enhancing resilience through major international policy platforms

One session during the workshop was devoted to discussing resilience in the context of international policy frameworks. Three international platforms in particular were highlighted in these discussions.

- First, the SDGs that were agreed to in September 2015 included substantial text on resilience across a number of goals and targets. Goal 1 includes a specific target devoted to resilience in the context of poverty (target 1.5, noted in the preceding section) and Goal 11 provides a major impetus for enhancing urban resilience. This apart, resilience is now firmly part of goals on combating climate change, protecting oceans, ensuring food security and supporting infrastructural and industrial development. The effective mainstreaming of resilience within this major global framework seen as a positive development, yet there was an acknowledgement of

challenges resulting from inadequate methodologies for tracking resilience at the national level.

- Second, the upcoming HABITAT 3 conference is another important global platform of relevance to the debate on resilience. This conference is focussed on prompting governments to rethink the urban agenda and ensure the equity and social justice are firmly part of debates on urbanisation, as well as supporting improved planning and modalities for operationalising the SDGs (with a special focus on goal 11 on resilient cities). Experts acknowledged that more than half the world's population now lived in cities that are disproportionately located along coasts and rivers, meaning resilience needs to be front and centre of any discussions on urbanisation. Background papers produced ahead of the conference already note the importance of urban resilience and call for cities to gear up for dealing with climate change and disasters.

- Third, the global climate change deal expected in Paris in December will also include aspect of resilience in the context of adaptation to climate vulnerability and change. While the emphasis in the build up to the conference has been largely on cuts to global greenhouse gas emissions, adaptation concerns will be front and centre of debates over securing sufficient pledges of and access to climate-related finance. Poorer and more vulnerability nations in particular will push to ensure that at least half of funding is made available for adaptation, which is their primary concern.

The meeting also including discussion on importance other importance events such as the 2016 World Humanitarian Summit and the implication of these international frameworks for civil society organisations. Overall, the substantial visibility received by resilience in these platforms and frameworks provides a unique opportunity to the community of practice working on resilience to design and deliver new initiatives to enhance resilience across the world. Also, these global frameworks enhance the ability of this community of practice to hold governments to account for focussing on and investing in resilience. Experts acknowledged an urgent need to ensure that tools and approaches of measuring/enhancing resilience start to align with these new and emerging policy directions instead of pulling in divergent directions.

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

'Listening in' on Twitter conversations on resilience: methods

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 as well as the ways through which various audiences engage with the communication process.

This section provides an analytical snapshot of the following:

1. Who are the key influencers generating and catalysing online conversations on resilience?
2. What are the popular topics in online conversations on resilience? What themes are being discussed prominently?
3. Where is the social media chatter on resilience originating from, and who is talking to whom?

Seven datasets comprising Twitter conversations on or specifically relevant to resilience in the context of eight sectors (climate, disasters, agriculture, food security, conflict, urban, water and economic) were created using the Twitter 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).

Making sense of the analysis:

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

- A word cloud showing the most frequently used terms in Twitter conversations on the concept of resilience in the sector. This represents a visual snapshot of the thematic focus of these conversations.
- A list of the most prominent discussion themes.
- A conversational social network map:
  - The network maps comprise nodes (which represent Twitter handles of organisations or individuals) and ties, which are the lines connecting the nodes (representing relationships and interactions).
  - The node size (or handle font size) helps the reader determine at a glance the key players in a network. The larger the node, the more its influence in terms of organisational prominence and/or conversational interaction.
  - The maps show conversational clusters which represent who is talking to whom on the pertinent topic (e.g., climate and resilience), with the Twitter accounts of prominence, often (but not necessarily) driving the conversations, in the centre. The closer a node is to the centre of its conversational cluster, the more vocal or influential in conversations on this topic is the player in question.[2]

The cross-cutting insights from this analysis are discussed at the end of the section.

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

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

2.1 Climate resilience

Conversations on climate resilience focus on:

- adaptation strategies to address climate resilience
- the role and treatment of gender in climate resilience programmes
- innovative financing mechanisms for climate resilience
- climate change, climate disasters and ways to reduce disaster risk
- innovation in alternative energy as a way to enhance climate change resilience.

Figure 1: Climate resilience word cloud

Figure 2: Examples of climate resilience tweets

ifpri @ifpri	David Chandler @DavidCh27992090	Rockerfeller Fdn @RockerfellerFdn
Ringler **@ifpri**: We must work to build women's **#resilience** in face of global **#climate** change & its impacts on food security **#IFPRIgender**	'**#Disaster** & **#climate** risks aren't seperate'- climate adaptation can undermine **#everyday #resilience**: **shar.es/1u5N4T** via **@SciDevNet**	"not enough is being done to protect communities against the effects of global **#climate change**." **ow.ly/SftOM @SciDevNet @ACCCRN**

Figure 3: Influence map of conversations on climate resilience
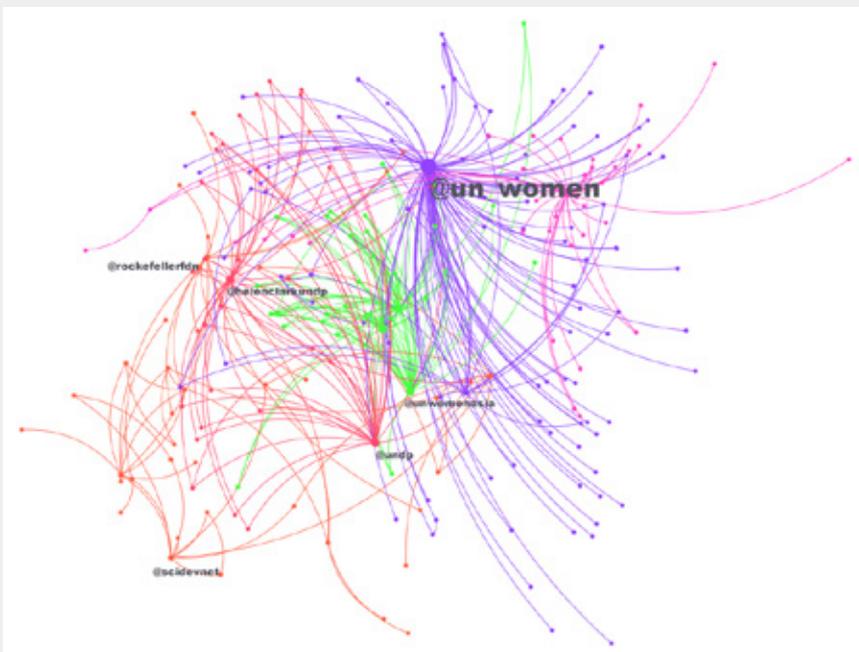
What changed since Resilience Scan 2015 Q1?

Themes of adaptation strategies and financing mechanisms for climate resilience continue to feature prominently. The notable change since the previous scan is the more visible discourse on the role of women in building climate resilience. This was primarily because there was a lot of chatter in the lead up to World Food Day on the role of women in enhancing resilience.

Top influencers on climate resilience:

- @UN_Women: UN entity for gender equality and women's empowerment
- @HelenClarkUNDP: Helen Clark, UNDP administrator and former Prime Minister of New Zealand.
- @RockefellerFdn: The Rockefeller Foundation.
- @UNDP: United Nations Development Programme

2.2 Agriculture resilience

Conversations on agriculture resilience focus on:

- reducing disaster risk by building resilience in fisheries and forestry
- the role of climate-smart agriculture and eco-agriculture
- approaches that enable smallholder farmers to increase resilience
- investment in new agricultural technologies that contribute to mitigating climate risk and improving agriculture resilience
- agriculture adaptation strategies in different contexts.

Figure 4: Agriculture resilience word cloud

Risk international water disaster livelihoods farm climate-smart dairy humandevelopment

Figure 5: Examples of agriculture resilience tweets

Forum 4 Agriculture @ForumForAg

#SDGs: 'increasing farm resilience is vital for achieving sustainable **#agriculture**' | LEARN MORE: qrs/ly/64t2in

ZeroHunger Challenge @ZeroHunger

Using **#climatesmart** agriculture to build farmers' **#resilience**: bit.ly/1KvLzI3 @WorldBankAfrica **#zerohunger**

LaikipiaRuralVoices @LAIKIPAIVOICES

Climate smart agriculture for communities' resilience in Matwiku **bit.ly/1Lfn4U5 #Paris #COP21 #CSA @JotoAfrica**

Figure 6: Influence map of conversations on agriculture resilience
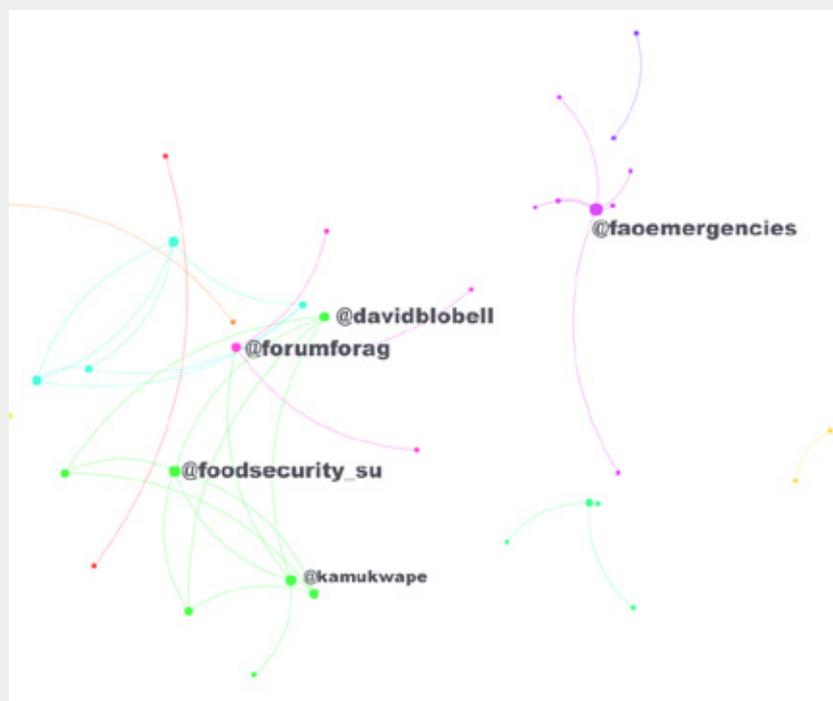
What changed since Resilience Scan 2015 Q1?

There is a consistent thematic congruence on agriculture resilience since the lasts scan, but tweets in the current scan period more emphasis on improving the resilience of smallholder farmers as well as climate-smart agriculture.

Top influencers on agriculture resilience:

- @ForumForAg: A Brussels forum on agriculture, food and environmental security
- @FoodSecurity_SU: Stanford University's Center on Food Security and the Environment
- @DavidBLobell: Associate Professor of Earth System Science and Deputy Director of the Center on Food Security and the Environment at Stanford University
- @FAOemergencies: United Nations Food and Agriculture Organisation twitter page focused on emergencies and food security crises

2.3 Food security resilience

Conversations on food security resilience focus on:

- interventions by international organisations aimed at addressing food security in vulnerable contexts
- approaches that enable smallholder farmers to increase resilience
- the intersection of agriculture, food security and resilience
- approaches to measure and understand food security resilience
- sustainable farming for strengthening food security resilience.

Figure 7: Food security resilience word cloud

Figure 8: Examples of food security resilience tweets

World Food Programme @WFP	Feed the future @FeedtheFuture	ifpri @ifpri
Strengthening **#resilience** for food security & nutrition in Guatemala, Kenya & Niger **wfp.org/RBA-joint-resi... #CFS42**	Heat-resilience wheat in South Asia ensures **#foodsecurity** for >20% of the world's population **ow.ly/STH5f**	Ringler **@ifpri**: We must work to build women's **#resilience** in face of global **#climate** change & its impacts on food security **#IFPRIgender**

Figure 9: Influence map of conversations on food security resilience
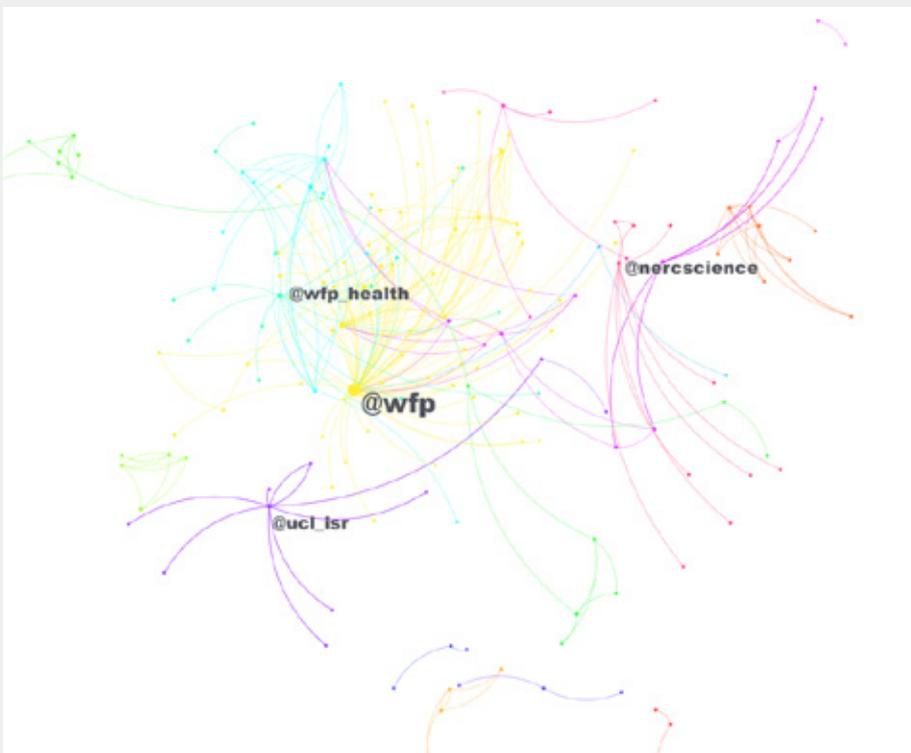
What changed since Resilience Scan 2015 Q1?

More discussions on the role of international organisations, as well as notable discussions on approaches to measure food security resilience as compared to the previous Scan.

Top influencers on food security resilience:

- @NERCscience: The UK's Natural Environment Research Council
- @WFP: The World Food Programme
- @WFP_Health: The World Food Programme's Nutrition Division
- @UCL_ISR: University College London's Institute for Sustainable Resources

2.4 Conflict resilience

Conversations on conflict resilience focus on:

- reducing impact of armed conflict on vulnerable populations
- moving beyond relief and focusing on rebuilding conflict-affected societies
- health and resilience in the context of conflict-affected areas
- community-based approaches that strengthen resilience in conflict areas
- improving emergency response in conflict-affected areas.

Figure 10: Conflict and resilience word cloud

Figure 11: Examples of conflict resilience tweets

ResilienceAfrica Net @AfricaResilient

How do we intervene in communities affected by conflict 4 **#Resilience** thru **#RIC4Conf**? Discussions **@ AfricaResilient @MakerereU @ GlobalDevLab**

EU Humanitarian Aid

By strengthening populations' resilience **@ICRC** & EU help reduce impact of armed conflict affecting millions **bit.ly/1MmVgtg #IDDR2015**

AllforPeacebuilding @AfPeacebuilding

Check out @MercyCorp' new report on improving **#emergency** response and **#resilience** in areas of **#conflict** now: **bit.ly/1OyljU8**

Figure 12: Influence map of conversations on conflict resilience
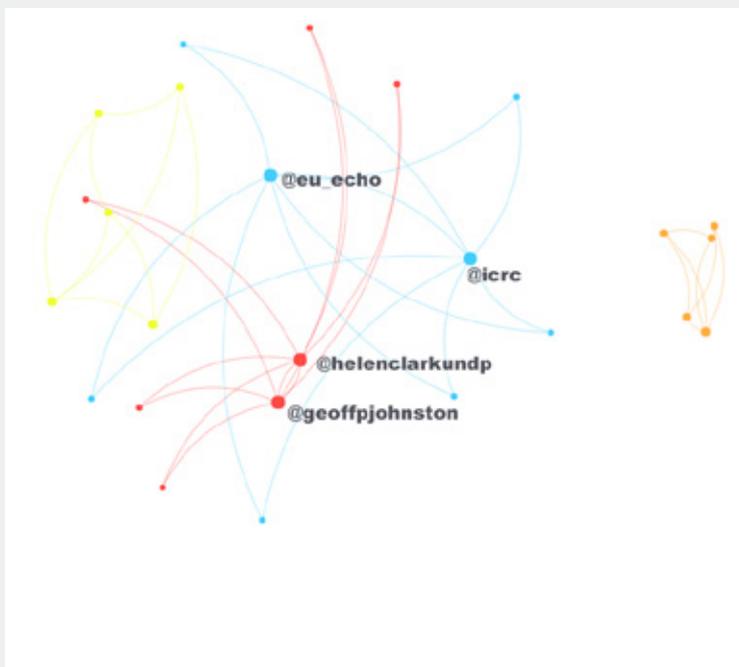
What changed since Resilience Scan 2015 Q1?

There is a marked increase in conversations and tweets relevant to conflict resilience since Resilience Scan 2015 Q1 due to the conflict in Syria and the refugee crisis. Thematically, conversations in this Scan focus more on emergency response rather than the role of trade in improving community resilience or post-conflict resilience building.

Top influencers on conflict resilience:

- @eu_echo: EU Humanitarian Aid, the EU's humanitarian aid and civil protection department
- @ICRC: International Committee of the Red Cross
- @GeoffyPJohnston: Geoffrey P. Johnston. Freelance journalist covering international relations, human rights, religious freedom, political economy
- @HelenClarkUNDP: Helen Clark, UNDP administrator and former Prime Minister of New Zealand

2.5 Urban resilience

Conversations on food urban resilience focus on:

- the relationship between urban resilience and socio-economic well-being
- the role of innovative design and engineering in strengthening urban resilience
- improving resilience of vulnerable urban communities to climate change
- pro-poor urban space design and infrastructure.

Figure 13: Urban resilience word cloud

engineering
Cities research
public slums
challenges
climate ideas poor
stories

Figure 14: Examples of urban resilience tweets

DFID Research @DFID_Research	**David Dodman** @dee_are_dee	**ICE** @ICE_engineers
How might urban **#slums** become more resilient to climate change? Add your ideas here: **ow.ly/Td4si @DFID_Climate #AMPLIFY**	7 practical steps for **#urban #resilience** - a blog by **@ AdiBahadur - gu.com/p/4cp4x/stw**	What do engineers have to offer those on the front line of urban resilience? We'll be discussing at **#ICEtriennial ice-conferences.com/the-civil-engi...**

Figure 15: Influence map of conversations on urban resilience
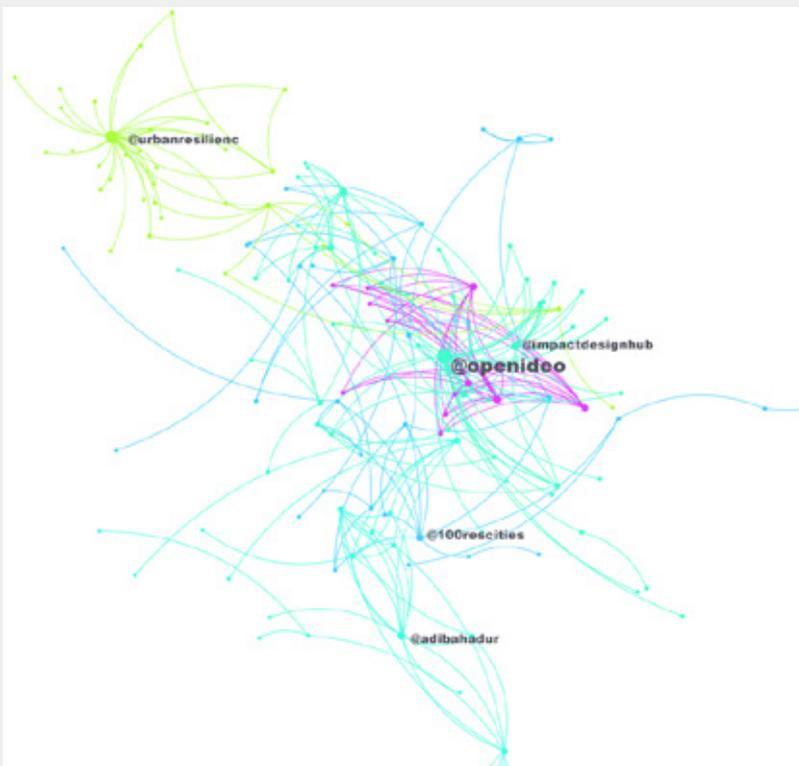
What changed since Resilience Scan 2015 Q1?

New (or more visible) discussions on urban design approaches that take into account vulnerable/poor communities. Themes of innovative approaches to improving urban resilience as well as the intersection of urban resilience and disasters continue to feature prominently.

Top influencers on urban resilience:

- @openIDEO: An online global open innovation platform
- @ImpactDesignHub: An online resource for architects, designers, makers and others 'committed to designing a better world'
- @100ResCities: A project by the Rockefeller Foundation that 'helps cities become more resilient to the shocks and stresses of the 21st Century'
- @AdiBahadur: Aditya V. Bahadur, Senior Research Officer, Adaptation and Resilience, Overseas Development Institute (ODI), UK

2.6 Water resilience

Conversations on water resilience focus on:

- the role of agricultural innovation (e.g. in soil health) in improving water resilience
- the impact of climate change on water resilience
- the intersection of energy, water resources and food security
- cases of successful improvement of water resilience in various local contexts.

Figure 16: Water resilience word cloud

floods security Emergency drinking safe pollution infrastructure drought foodsecurity

Figure 17: Examples of water resilience tweets

Michael Kramer @naturalinvest	**Global Resilience** @grp_resilience	**BID Sector Privado** @BIDSecPrivado
A key to social resilience in coming decades will be providing fair & reliable access to water. Private companies? **bit.ly/1YR6Xly**	Faces of **#Resilience**: Global impacts starts w/ local roads & communities for **@RoadsForWater bit.ly/1ES5hPm**	RT **@100rescities**: "When we talk about water, cities are where things are happening," **ow.ly/S6H4v #WWWeek** cc: **@BIDinfra**

Figure 18: Influence map of conversations on water resilience

What changed since Resilience Scan 2015 Q1?

Conversations on droughts, floods and agriculture still feature prominently. Tweets that feature case studies and/or success stories in improving water resilience enjoy high reach and visibility.

Top influencers on water resilience:

- @GlobalResSummit: The Global Resilience Summit
- @KasimReed: Kasim Reed, the 59th mayor of the City of Atlanta, USA
- @Acclimatise: A 'specialist consulting, communications and digital application company providing world-class expertise in climate change adaptation and risk management'
- @buildresilience: Resilience.org, 'an information clearing house and a network of action-oriented groups, focused on building community resilience'

2.7 Economic resilience

Conversations on economic resilience focus on:

- the relationship between economic growth and carbon emissions, and consequent implications for climate resilience
- disaster risk reduction vis-à-vis economic growth
- the role of cleantech in enhancing economic resilience and sustainability
- the ways by which cities can enhance economic resilience.

Figure 19: Economic resilience word cloud

Figure 20: Examples of economic resilience tweets

Post Carbon Inst.   @postcarbon

The Decoupling Debate: Can Economic Growth Really Continue Without Emission Increases? **dlvr.it/ CRD1sg** (**@buildresilience**)

Resilience Kenya @ResilienceKenya

#BuildingResilience - UNDP Kenya focuses on youth economic empowerment to build resilience to disasters, **#Tana**, Kenya

100 Resilient Cities   @100ResCities

#Ask100RC Q from **@JetSetUrbanista** for **@billpeduto**: What are cities doing to address issue of economic resilience (unemployment, mobility)?

Figure 21: Influence map of conversations on economic resilience
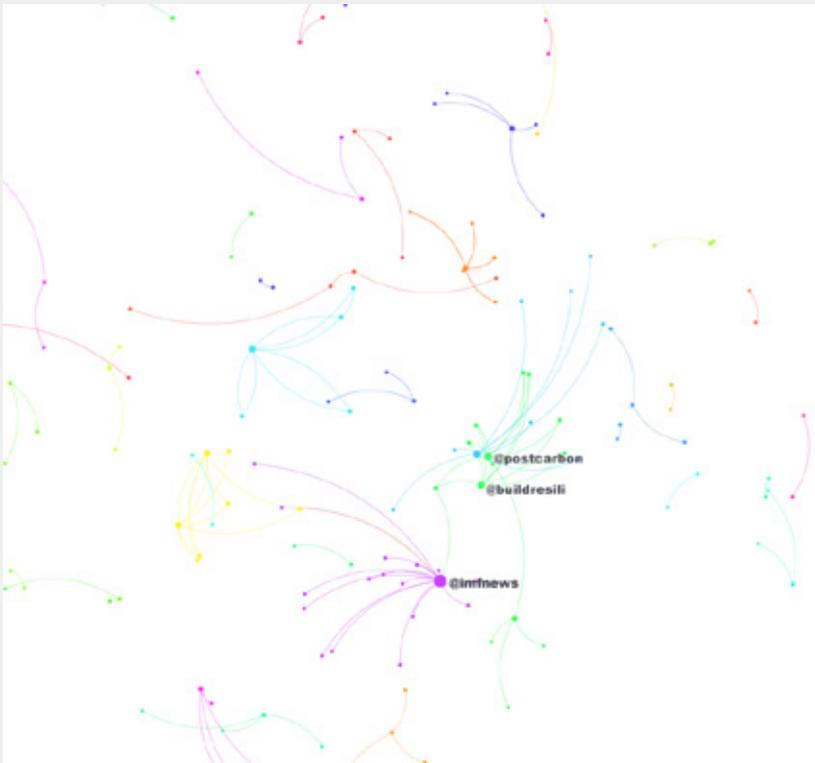
What changed since Resilience Scan 2015 Q1?

There is significantly less talk about governance and economic resilience and more about the relationship between economic growth and carbon emissions. New conversations on cleantech and economic resilience and sustainability.

Top influencers in conversations on economic resilience:

- @IMFnews: The International Monetary Fund
- @buildresilience: Resilience. org, 'an information clearing house and a network of action-oriented groups, focused on building community resilience'
- @postcarbon: The Post Carbon Institute.

2.8 Conclusions

What does Twitter discuss when discussing resilience?

In comparison to the analysis done in Resilience Scan 2015 Q1,[3] climate resilience still has the most prominent discursive visibility among the seven sectors analysed, followed by conflict and water resilience.[4] Economic resilience is the least discussed sector.

In terms of cross-cutting themes, women and gender issues feature more prominently in tweets on resilience as compared to the last scan, as do issues relevant to local responses and cases studies (evident in the word clouds where keywords like "'communities"' feature prominently), especially in the context of climate resilience. Discussions on disaster risk enjoy less visibility than in Resilience Scan 2015 Q1.

Who tweets about resilience?

The most vocal and influential voices discussing resilience on Twitter continue to be expert organisations, NGOs and donors. As evident from the network diagrams, the nodes closer to the centre are almost all expert/institutional accounts.

How is resilience tweeted about?

- The bulk of tweets about resilience seem to be formal in nature with less discursive engagement. That is, most tweets are used to broadcast links to blog posts or articles, not to initiate engaging discussions. Also, some twitter streams seem to focus on certain events and conferences relevant to resilience, as opposed to consistently tweeting about the topic.

- Twitter networks about resilience seem to have little engagement with relevant conversational circles. For example, while there are a lot of tweets on the role of innovative design and engineering in improving urban resilience, there doesn't seem to be much interaction or network overlap on this topic between experts from resilience and those from urban design/engineering circles. This is more so in some sectors with conversational clusters that are highly centralised around certain organisational voices (e.g. climate resilience).

Figure 22: Thematic distribution of Twitter conversations on resilience

- Climate 37%
- Conflict 20%
- Water 16%
- Agriculture 10%
- Food security 8%
- Urban 5%
- Economic 4%
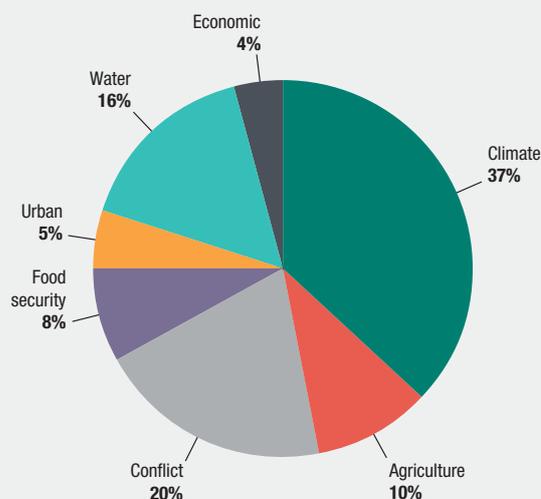
- It is worth noting that this study uses a set of topics (issues) to generate a snapshot of conversational networks and thematic structures around those specific issues. Certain issues may have a 'donor effect' that determines the extent to which certain themes achieve certain prominence due to, say, the significant focus of a research funding. In future reports, it might be worth exploring what happens to certain issue networks when influential voices are removed from the conversational clusters, and the extent to which certain themes hold together more consistently over time (thus revealing consistent thematic congruence that is not necessarily attributed to events, grants or other variables that cause spikes in conversational visibility on some issues).

- This study adopts a topic-driven approach. Since the network maps and conversational clusters generated from the datasets represent the accounts which are central to how the relevant topics are discussed at a certain point in time, these networks are in constant flux, and 'influence', as a measure of impact on how a topic is communicated, is constantly changing.

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3   http://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9782.pdf

4   There is a lot of overlap between water, agriculture and food security datasets, so these figures are based on keyword analysis that offers a thematic snapshot at the point of analysis, and do not account for variables that may cause certain themes to feature more prominently, such as important conferences.

3. Resilience in the grey literature

Our examination of articles on resilience published between July and September 2015 includes 16 grey literature publications from research institutions and aid agencies. These span five broad themes: monitoring and evaluation, subjective resilience, policy and planning, social protection and resilience, and climate-smart agriculture. These analytical clusters differ from those developed in the previous scan that included urbanisation and resilience, ecosystems and resilience, finance and resilience, and fragile states. Only one cluster on 'monitoring and evaluation' remains the same between the two scans (the same section also appeared in the first scan for 2015) which is reflective of the substantial amount of effort that is being put into investigating novel approaches of measuring resilience and testing the efficacy of interventions to build resilience.

3.1 Monitoring and evaluation

> **Grey literature on monitoring and evaluation suggests:**
>
> - To measure changes in resilience, collecting data at frequent intervals is necessary.
>
> - The complex systems that impact individual resilience can best be measured using multiple assessment techniques simultaneously.
>
> - Theoretical resilience frameworks are often mismatched with the general development-oriented indicators used to track resilience outcomes.
>
> - Conceptualising resilience as a set of anticipatory, absorptive and adaptive capacities is flexible enough to evaluate resilience outcomes across a variety of contexts and interventions.

As resilience programmes proliferate, practical questions about how to understand and measure resilience have become central for researchers and practitioners alike. Of the 16 publications in the sample, nearly half were focused on methods of measuring resilience (with two focused specifically on capturing dimensions of subjective resilience). The publications range from the highly practical, listing which available panel datasets already include resilience indicators, to the theoretical, with analysis of how systems thinking can help situate

'Of the 16 publications in the sample, nearly half were focused on methods of measuring resilience.'

resilience interventions within a broader and complex set of political, social, and ecological networks.

In a detailed working paper, Schipper and Langston (2015) review resilience frameworks to catalogue indicators for resilience and understand what these indicators revealed about the concept. Amongst the 17 frameworks in the sample, the authors find that every framework is influenced by its distinct theoretical entry point, complicating attempts to compare amongst them. The authors argue that there is a clear gap between theory on resilience and the way in which indicators focus on well-being and general development factors. As the resilience frameworks currently stand, general development-oriented indicators may not provide a complete picture of resilience.

In a new framework which applies theory directly to practice, Bahadur et al. (2015) advance a method for measuring resilience outcomes that breaks down resilience into three distinct capacities – anticipatory, absorptive, and adaptive. The '3As' framework is designed to apply across a broad variety of contexts, and is being used to track progress in the Building Resilience against Climate Extremes and Disasters (BRACED) Programme of the Department for International Development (DFID), which is deploying a range of resilience-centred projects in 15 countries. Within this framework, anticipatory capacity is centrally concerned with being able to prepare for and plan for climate risks; absorptive capacity is the ability to buffer the immediate impacts of a disturbance without compromising long-term well-being; and adaptive capacity is the ability to adapt to multiple, long-term climate risks. Adaptive capacity is generally considered to be 'good development' interventions, but it also includes the capability to learn from disasters and build back better.

Together, these capacities create the enabling conditions for transformation, which is touched upon in this paper but deliberately excluded from the framework. The authors argue that transformation is not a distinct capacity but an approach that can reshape, enable and enhance people's ability to adapt, anticipate, and absorb shocks.

In a substantial contribution to research approaches to evaluating resilience, the Food Security Information Network's (FSIN's) Resilience Measurement Technical Working Group published a series of technical papers on measuring resilience in September 2015. In *Systems Analysis in the Context of Resilience*, Mock et al. (2015) apply systems thinking to understand how communities and households living in vulnerable areas are part of complex and interrelated political, ecological, economic, and social networks. There are feedback loops within systems, and changes in one level (national governance, for instance) can have overlapping effects on another scale (community governance). To better capture the multi-scalar dynamics of resilience, Mock et al. argue for multiple method assessment techniques. This could be done using crowdsourced SMS data, satellite data, and social network analysis, ensuring that softer elements of resilience such as social capital, governance structures, and ecological indicators are all included for a better understanding of the components of a truly resilient system.

Taking a narrower focus, Choularton et al (2015) explore the varied nature of shocks and stresses and how to best capture households' abilities to cope with them in *Measuring Shocks and Stressors as part of Resilience Measurement*. Strengthening resilience to one type of shock or stressor does not necessarily improve resilience to another shock, and some shocks may contribute to others. High food prices may lead to political instability, for instance, and a household that relies on subsistence agriculture may be insulated from the effects of high food prices but be particularly exposed to the impacts of droughts. The paper argues that stressors, or long-term pressures and extensive risks that are less intense but more frequent, are often left out of resilience measurement but are essential to understanding the factors that undermine the stability of the system. To measure shocks and stressors at multiple scales and over different time periods, the authors advocate using subjective and objective measures of resilience to examine how shocks and stresses are interrelated. Subjective indicators can include perceptions of flood risks and ability to recover, while objective indicators are illustrated by severity of storm damage to household assets and intensity of the storm itself. Choularton et al. advocate for more empirical work to determine how small-scale extensive risks and large-scale intensive risks can be measured concurrently.

The basic, practical features of a resilience monitoring and evaluation (M&E) approach are detailed in *Household Data Sources for Measuring and Understanding Resilience* (Carletto et al., 2015), which examines methodological aspects of resilience M&E in a field where there are no standardised methods for collecting data. The paper details various datasets and surveys that can be applied, stressing that integration across survey instruments is key for understanding the spatial and temporal context of resilience and enhancing analytical potential. Carletto et al. emphasise that collecting data at high frequency over a long timescale is the best method for learning about resilience against all types of disturbances. This finding that is reinforced by Headey and Barret (2015), who advocate for investment into a systematic approach to collect data in a few sentinel sites in the world's most vulnerable areas. Because household surveys do not always capture the determinants of human well-being in the face of emerging risks, they can be irrelevant. Resilience data needs to be collected at a high frequency to better understand shocks, and sustained over a period of many years to understand changes over time. Though the costs involved in a longitudinal sentinal study would be high, the authors argue that splitting the costs amongst organisations working in resilience building would render this feasible, and simultaneously create a multi-country network of partners that can work together to attain a holistic understanding of the factors that enhance resilience.

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3.2 Subjective resilience

Amongst M&E experts and development practitioners, subjective resilience is emerging as a useful approach for gauging resilience information that cannot be captured purely through objective models, including perceptions, opinions, judgements, social interactions, preferences and self-assessments. Two papers address subjective resilience specifically, though it is mentioned across the monitoring and evaluation literature.

Jones and Tanner (2015) describe the value of measuring 'subjective' resilience at the household level. The paper argues that objective frameworks that measure socio-economic variables are not sufficient to capture less tangible elements of resilience, and that people themselves have a good understanding of the factors that contribute to their ability to anticipate, absorb, and adapt to shocks and stresses. By combining traditional objective methods with surveys that ask people to provide qualitative assessments of their resilience, insights can be gained about the contextual factors that contribute to people's ability to handle disturbances. These cognitive evaluations of household capabilities can inform selection of indicators for resilience assessments and bring bottom-up perspectives into a field typically dominated by experts.

The value of subjective resilience is corroborated in Maxwell et al. (2015), *Qualitative Data and Subjective Indicators for Resilience Measurement*, which argues that resilience measurements needs multiple methods of assessment to gauge characteristics of social-ecological systems (SES), including information on subjective resilience. Perceptions of preparedness, psychological well-being, social relationships, trust and power all impact people's vulnerability to hazards and their capacity to deal with the impacts of shocks. Similarly to Jones and Tanner (2015), the authors argue that qualitative information can be used to shape quantitative instruments. Combining objective and subjective information to measure resilience outcomes over time can provide a more holistic picture of the elements that enhance household and community resilience.

'Subjective resilience is emerging as a useful approach for gauging resilience information that cannot be captured purely through objective models'

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3.3 Social protection and resilience

Grey literature on social protection and resilience suggests:

- Social protection, climate change adaptation, and disaster risk reduction share a common goal of supporting resilience for the most vulnerable.
- Integrating social protection into disaster management policies can improve early recovery and support resilient livelihoods.

Development partners working to improve resilience are increasingly focused on the role social protection can play in reducing vulnerability to natural hazards and idiosyncratic life shocks. This quarter, two reports discuss how social protection is key to moving programming beyond emergency support after disasters in states with high vulnerability. For Myanmar, the World Bank (2015) advocates for more expansive social protection to strengthen the country's poverty reduction strategy and reduce risks resulting from natural exposure and ongoing political reforms. The paper argues that having stronger coordination between social protection programmes and disaster risk management (DRM) policy will improve early recovery by supporting livelihoods and asset creation before a shock. The report argues for a flexible and scalable social protection programme modelled on Ethiopia's Productive Safety Net Programme (PSNP), which provides support for the rural poor facing chronic food insecurity. A programme activated by early warning triggers could reduce economic impact of disasters on households, particularly for people employed in the informal sector with no income security that are currently excluded from Myanmar's small social protection schemes.

In Vietnam, CARE (2015) analysed the synergies between social protection, climate change adaptation, and disaster risk reduction. All three fields have a common goal of supporting resilience against shocks and stresses for the most vulnerable, and a few ongoing programmes unrolling agricultural insurance or providing cash transfers in Vietnam have showed early success in improving livelihoods by better integrating climate change adaption (CCA), disaster risk reduction (DRR) and social protection concerns. The article recommends that social protection mechanisms consider built-in feedback loops with early warning systems to determine how climate change can impact the schemes. The paper also argues that a livelihood oriented approach in all three fields can enhance resilience, as existing social protection funds are not spent on livelihood support and DRR spending is heavily geared towards infrastructure spending and awareness raising. These reports reflect a growing recognition that social protection schemes can

have symbiotic goals with DRM and CCA programmes, and more harmonious policy and programming can improve resilience capacities for the poorest in developing countries that are particularly prone to natural hazards.

3.4 Policy, planning and resilience

Grey literature on policy, planning and resilience suggests:

- Integrating vulnerability assessments into municipal policy requires involving the right political actors and engaging them in a continuous process of resilience planning.
- Climate Action Plans must be coordinated with regular planning and budgeting mechanisms in government agencies.
- Recommendations from vulnerability assessments or Climate Action Plans should be allocated additional funding in order to avoid being a stand-alone exercise.

A running theme across five reports is the importance of linking vulnerability assessments and climate planning directly with government policy and budgets. This research is spearheaded by the Asian Cities Climate Change Resilience Network (ACCCRN)'s recent working paper series on climate resilience in Asian cities, which stresses the importance of improving collaboration for resilience-related assessments and linking them more strongly to policy and budgetary decisions. In a working paper on climate change vulnerability assessments (CCVAs) in Indonesia, Taylor and Lassa (2015) assess whether different CCVA methodologies that had been applied in projects across various states made any ripples in municipal and government policy, and what were the factors that enabled CCVAs to influence decision-making processes. The assessment reveals a set of common characteristics amongst the successful CCVAs. Firstly, they were not a series of isolated activities but part of a continuous process. Secondly, implementation of the CCVAs was highly dependent on a team of strategic actors that drove the process; successful CCVAs reflected the commitment of local political actors and government officials. The authors recommend creating specific institutional arrangements, such as ACCCRN's City Team (a multi-disciplinary team comprised of municipal decision makers, civil society organisations, and local universities tasked with leading efforts to build resilience in the city of Bandar Lampung, Indonesia) to create ownership over the results of the assessment. Overall, the authors conclude that the success of vulnerability assessments' ability to influence policy was not a technocratic issue but a political one. Including the right political actors and maintaining a continuous process of involvement were key for policy results.

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Taylor and Lassa's points are reiterated in Nguyen et al.'s (2015) piece evaluating Climate Action Plans in Vietnam, applying a framework of six international good practices in climate planning to assess how these action plans were being applied in practice. As in the case of the CCVAs in Indonesia, the study found that many recommendations within the plans could not be implemented due to a lack of coordination with regular planning and budgeting mechanisms in governmental technical agencies. Furthermore, Vietnam's Climate Action Plans had no provisions for additional funding outside of regular public expenditure. States were expected to implement the recommended actions, in spite of the fact that no dedicated funding had been budgeted for the Climate Action Plans. In some locations, implementation was further undermined by limited application of risk assessments and weak treatment of climate uncertainties. Planning documents have little practical value where they are not tied to political processes.

Similarly, a study on urban climate resilience in Dhaka, Bangladesh, argues for improving connection of climate resilience issues between all actors involved in the urban

sanitation sector, which is a source of vulnerability for those living in slums with poor drainage and inconsistent access to safe water. Alam et al.'s investigation (2015) reveals that NGOs and municipal agencies tasked with urban water and sanitation issues fail to coordinate amongst themselves for better service delivery. The authors suggest that the government should formulate policy and working guidelines for urban sanitation, which would give NGOs documents to align their activities with and ensure better collaboration between NGOs and the government. NGOs play a vital role in improving sanitation services in slums, but their project-based activities cannot have long-term resilience implications without alignment with government policy and processes.

Lastly, a IIASA and Zurich (2015) report presents a methodology to assess and manage flood resilience developed by the Zurich Alliance partners involved in humanitarian work. The report argues that development affects all flood risks both positively and negatively, and understanding these impacts requires the engagement of stakeholders at all decision-making levels. Building on a body of established community engagement processes from the Zurich Alliance's NGO partners, IIASA and Zurich designed a toolkit to facilitate iterative learning about flooding. The programme uses a modified adaptive management cycle: it begins with a comprehensive assessment that leads to selecting specific actions to reduce risks. Results are evaluated and new initiatives are amended in a non-linear process, depending on the needs of each particular community. The methodology is underpinned by a commitment to stakeholder engagement, as the report argues that wider stakeholder engagement generates shared insight on the underlying cause of flood risk and informs policy at the local and national level.

'The report argues that development affects all flood risks both positively and negatively, and understanding these impacts requires the engagement of stakeholders at all decision-making levels.'

3.5 Climate-smart agriculture and resilience

Grey literature on climate-smart agriculture and resilience suggests:

- 'Climate-smart agriculture' is not clearly defined, leaving room for diverse visions of what the concept means in practice.
- Not all climate-smart agriculture projects are grounded in decades of practice in sustainable agricultural development.
- Existing climate-smart agriculture policy is weak on gender inclusion and lacks clear commitments to agroecological farming methods.
- Attempts to mainstream gender into climate-smart agriculture programmes should be designed to tackle the institutional arrangements that allocate different decision-making benefits to men and women.

A wariness of the value of the terminology 'climate-smart agriculture' emerges out of two articles investigating the links between climate-smart agriculture and resilience this quarter. Though the need for resilience in small-scale agricultural systems is taken as a given, the grey literature discusses the possibility that the concept of climate-smart agriculture is an attempt to 'reinvent the wheel' rather than ground practice on decades of experience in sustainable agricultural development. The vision for climate-smart agriculture is diverse, and the authors caution against a superficial inclusion of gendered concerns or an overreliance on farming methods with short-term gains for farmers and the environment.

Greenpeace's recent report on ecological farming methods to build resilience to climate change in Kenya, calls for donors and governments to shift investment away from industrial agriculture practices and towards sustainable ecological practices. It identifies four key elements for agricultural resilience: 1) improved soil fertility and long-lasting soil health, 2) increased local water availability for cropping, 3) diversification of agricultural inputs and processes to ensure adaptive ability at farm level and increase nutrition, 4) strengthened community support networks. The report applies these four cornerstones of agroecological farming to examine the results of projects focused on building food security. It addresses failures and successes in turn, finding that some 'climate-smart' agriculture projects exacerbated vulnerability by increasing farmers' dependence on expensive external inputs, causing soil quality issues, and introducing water-intensive projects in places where existing resources were limited.

In a CGIAR policy brief, Vermeulen (2015) describes the climate-smart agriculture movement as non-prescriptive; it does not explain how to manage inevitable trade-offs or achieve outcomes for agricultural productivity, as the concept assumes that locally appropriate solutions to evolving climate-related pressures will be generated. Taking a gender lens to understand how the movement can specifically address the needs of women, Vermeulen questions whether policy goals of climate-smart agriculture are simply designed to maximise women's access to agricultural information and technologies within existing power relations, or whether they would tackle distribution of assets and decision-making where these are underlying causes of women's vulnerability. Climate-smart agriculture is not merely a technical issue but one that deals with institutions that allocate different decision-making powers and benefits to men and women. According to Vermeulen, existing climate-smart agriculture policies are weak on gender inclusion. Policy-relevant evidence on gender within climate-smart agriculture should go beyond adoption of new technologies and consider the politics of resource allocation.

'Climate-smart agriculture is not merely a technical issue but one that deals with institutions that allocate different decision-making powers and benefits to men and women.'

4. Review of peer-reviewed journal literature on resilience

This resilience scan reviews 36 journal articles published between July and September 2015. The articles are categorised into five dominant themes:

- **Politics and governance** – which looks at the political economy of disasters, interrelationships between different factors or parts of a system, adaptive and multi-level governance, and multi-stakeholder engagement
- **Urban resilience** – which looks particularly at urban physical resilience through access and provision of infrastructure and technology
- **Ecosystem-based adaptation and natural resource management** – which looks at land use management and planning, water resource management and ecosystems
- **Agriculture and livelihoods**
- **Framing and measuring resilience**

These are different from the analytical clusters that emerged in the previous scan that were methods and approaches, theory and frameworks, governance and policy, marginalisation and inclusion and business and economics. There are some overlaps between 'framing and measuring resilience' that has emerged as a category in this scan period and the one on 'theory and frameworks' in the previous scan. Both present theoretical overviews of issues that must combine to deliver resilience.

'Power networks can have an impact on resource distribution and people's ability to participate in post-disaster relief efforts, thereby affecting a person's ability to recover from a disaster'

4.1 Politics and governance

Papers on politics and governance suggest:

- Using political-economy approaches to understand resilience-building policy processes allows us to take into account the different socio-economic and political factors that marginalise or exclude certain people, whilst making others privileged and elite.
- An integrated approach for governing disaster risk and resilience is necessary to manage the interdependencies that exist within a system.
- Using adaptive and multi-level governance can help deal with the complexities of climate change and the dynamics of social-ecological systems.
- Multi-stakeholder engagement across scales from the local to national to supranational is essential for disaster management to be effective and to help build resilience at all levels and across sectors.

Political-economy of disasters

Many of the articles focused on the political-economy of disasters. Nadiruzzaman et al. (2015) consider the political economy of disasters and resource distribution in post-disaster situations, using Cyclone Sidr as a case study. They examine networks, and the different socio-economic and political factors that marginalise or exclude certain people whilst making others privileged and elite. The authors argue that these power networks can have an impact on resource distribution and people's ability to participate in post-disaster relief efforts, thereby affecting a person's ability to recover from a disaster. Tang et al. (2015) also consider the impact that governance has on marginalised groups in rural China. They expose the lack of social and physical resilience of rural communities in inland China who were more adversely affected by the Wenchuan earthquake because of poor infrastructure and degraded ecological systems. The authors argue that 'systematic governance improvements in China'

(p.1111) are needed to assist these marginalised groups and to enable 'rural dwellers to have adequate capacities to enter the virtuous circles of economic activities as well as benign ecological cycles' (p.1130). In an article that quantifies the adaptive capacity of coastal fishing communities in Kenya, Cinner et al. (2015) collect data disaggregated by different social groups (migrants, the poor, the elderly and those involved in decision-making) in order to examine how local adaptive capacity varies within a community, and also how adaptive capacity changes over time. Socially disaggregated analyses showed that these politically marginalised groups were the least 'prepared for adapting to change in these resource-dependent communities' (p.1). Moreover, the results found that people who do not participate in decision-making also have 'limited agency to influence resource governance and how it affects them … [and] decisions are unlikely to consider their interests or protect their livelihoods (which may increase their exposure)' (p.2).

Chelleri et al. (2015) provide another example of the political economy of integrating resilience within neglected neighbourhoods in Mexico. They consider the integration of 'urban sustainability and urban resilience principles and practices' (p.122) in the shaping of urban areas, using an example from a deprived neighbourhood in Mexico City, where 'resilient and sustainable urban transformation was achieved through an integrated and sustainable decentralized water management and infrastructure plan' (p.122). The article reflects on the importance of a people-centred, well-being approach, and the need for a transition towards decentralisation – the barriers of which they argue are political not technical. Sadiq and Noonan (2015) take a different approach to this idea, looking at the characteristics and motivations of communities that changed their flood risk mitigation behaviour and responded strategically through collective action to a top-down incentive and loan scheme. The scheme is based on a community rating system (CRS) which aims to enhance incentives for communities to build local capacity to reduce flood losses, including through 'discounted premiums (up to 45%) on federally required flood insurance, respective to their community's CRS score'

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(p.1416). The authors find that 'communities with more information-based flood management activities, lower property values, lower flood risk, and lower population densities are more likely to respond strategically with respect to smaller CRS subsidies. For larger subsidies, the results indicate that CRS communities with higher property values are more likely to respond strategically to the policy incentives' (p.1413). Nevertheless, the authors argue that the CRS incentive structure 'distorts the efforts of participating communities' (p.1425) and does not raise understanding about why or how much communities are responsive to such initiatives, which would help policy-makers 'promote greater resilience through carefully designed incentives' (p.1426).

Interrelationships and a system-based approach

Recognition of the interrelationships between different factors or parts of a system, and the necessity for an integrated approach to governance was highlighted during the review. James and Friel (2015) attempt to understand the interrelationship between different food sectors, subsystems, environmental change, health and equity. They take a whole-of-food system perspective that examines the food supply chain, production, distribution and consumption across a range of food subsystems from industrial to localised food chains. The analysis found that: '(i) industrial food production

'The article reflects on the importance of a people-centred, well-being approach, and the need for a transition towards decentralisation – the barriers of which they argue are political not technical.'

'Different urban stakeholders have different objectives and contexts that they need to address, which is a political challenge for achieving an integrated approach to managing these interdependencies'

systems can be more environmentally sustainable than alternative systems, indicating the importance of multiple food subsystems for food security; (ii) a variety of food distributors stocking healthy and sustainable items is required to ensure that these items are accessible, affordable and available to all; and (iii) it is not enough that healthy and sustainable foods are produced or sold, consumers must also want to consume them' (p.2499). The authors consequently conclude that an approach is needed that cuts across scales and sectors so as to ensure that urban food systems are 'adaptive to climate pressures and help ensure nutritious food is available and accessible to all communities in ways that mitigate further environmental harm' and that are demand

driven (p.2499). Conversely, Hasan and Foliente (2015) examine the complexities and interdependencies that exist within an urban infrastructure system, studying the possibility of cascading infrastructure failures that are possible within such systems. They consider infrastructure modelling approaches and broader socio-economic impact assessment methods in the face of uncertainty, and argue that in order to achieve effective loss mitigation measures, urban stakeholders need to take these interdependencies 'explicitly into account in their policy, investment, operational and planning decisions, considering different spatial and temporal levels' (p.2144). Nevertheless, the authors also recognise that different urban stakeholders have different objectives and contexts that they need to address, which is a political challenge for achieving an integrated approach to managing these interdependencies. Similarly, Landauer et al. (2015) analyse the trade-offs, drivers and synergies for the interrelationship between adaptation and mitigation policies and practice in urban areas, and argue for the need for integrated adaptation and mitigation climate policies that are contextual and drive synergies in regulation, legislation and policy innovations; examples of these synergies are mainly linked to 'building, infrastructure and energy sector solutions, such as passive building design, urban greening and alternative energy options' (p.515).

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Adaptive and multi-level governance

In order to manage different interrelationships, priorities and needs within a system, a number of the articles argue for the importance of, or need for, adaptive and multi-level governance to help deal with the complexities of climate change and the dynamics of social-ecological systems. When examining community relocation as an adaptation strategy to respond to the effects of climate change, Bronen (2015) proposes using a social-ecological monitoring tool to assess whether and when climate-induced relocation needs to occur. The author also uses an adaptive governance framework which encourages multi-level participation of community residents and governance institutions as well as collaborative decision-making processes to help guide proactive adaptation strategies that could help to 'avoid or minimize the harmful effects of government-mandated relocations' (p.2). Cooper and Wheeler's article (2015), using a case study from rural Uganda, provides a good example of how adaptive governance can be used to promote resilient livelihood outcomes. The authors promote multi-stakeholder engagement, collaboration and learning, alongside the need for leadership and innovation, emphasising the importance of 'mainstreaming adaptation alongside existing policy trajectories; and highlighting the significance of collaborative spaces for stakeholders and the tackling of inequality and corruption' (p.96).

Bell and Morrison (2015) provide a comparative analysis of the transformation of two governance systems for flooding: adaptive governance and precautionary governance. They consider three dimensions associated with 'the ability of governance to transform: detection of change, cross-scale interactions and capacity to reorganize over time' (p.517). The paper finds that although a precautionary regime is often

'In order to manage different interrelationships, priorities and needs within a system, a number of the articles argue for the importance of, or need for, adaptive and multi-level governance to help deal with the complexities of climate change and the dynamics of social-ecological systems.'

regarded as a more 'desirable approach to flood risk mitigation (Kates, Travis, & Wilbanks, 2012), a "living with flood" approach under an adaptive governance regime is more likely' (p.530). The paper recognises that both types of governance are heavily path dependent, and concludes that adaptive governance needs to be supported by an 'overarching government regulation [of land use in flood-prone areas] and multi-actor networks in order to guide and incentivize' such an approach; it also argues that this needs to be scaled up over time so that they are 'supported by a more precautionary overarching style' (pp.517-8) through both state and non-state action (p.531). Vedeld et al. (2015) demonstrate the success of multi-level governance of climate change adaptation and flood risk management, resilience and co-production in a medium-scale city in Saint Louis, Senegal. They examine some of the tensions and trade-offs required to implement these policies, and predicate that medium-size cities are more likely to be able to achieve successful local adaptation policies due to their size and likely ability to arrange 'coproduction within the system of multi-level governance' in contrast to larger cities where there are many more conflicting priorities and multi-scale actors, networks and policies at play' (p.23). Meanwhile, Maisharou et al., (2015) highlight the need for sustainable land management approaches, practices and techniques in the Sahel, Africa, that could be used as a tool for the 'harmonisation of interventions between the major sub-sectors' (agriculture, livestock, water resources and the environment) with respect to land use, and that can be used as a solution for 'land restoration, mitigation of climate change, and resilience of rural population[s] to external shock' across the Sahel (p.1).

Multi-stakeholder engagement

Multi-stakeholder engagement across scales from the local to national to supranational is essential for disaster management to be effective and to help build resilience at all levels and across sectors. Islam and Walkerden (2015) examine relationships between NGOs and local households in Bangladesh. They explore social networks and some of the strengths and weaknesses in these linking relationships, finding that NGOs in their study concentrate more on response and relief, rather than preparedness and disaster risk reduction, recovery and resilience, regardless of the communities' priorities. In contrast, Webb et al. (2015) demonstrate a seemingly very successful model of NGO collaboration in Vanuatu, in which six organisations explored challenges, tools, best practice and ways of cross-sectoral working for successful participatory approaches to community-based adaptation. The partners worked in a collaborative and reflective way, in

which they developed the Vanuatu Climate Adaptation Network, a programme and area of work, as well as the Vanuatu Community Resilience Framework. Using the same framework, partners were then able to co-design tools, or use their own tools and approaches under a shared vision that took a cross-sectoral approach and enhanced co-ownership. Other articles also highlight a multi-sector, multi-scale approach that facilitates local-level engagement, community planning and community-based adaptation. Wongbusarakum et al. (2015) for example present a Local Early Action Planning (LEAP) tool that facilitates community-based adaptation planning in Micronesia, looking at social and ecological aspects, tools, knowledge and communication of climate information. The tool considers multi-sector planning to ensure integration and uptake of adaptation strategies. The tool was developed through training workshops and engagement with community members and other stakeholders, which included assessing challenges, lessons learned and input from the groups involved in implementing the tool; themes included 'climate communication, community facilitation, application of the LEAP tool, integration of local and scientific knowledge, multi-sectoral engagement, and additional technical expertise and support' (p.388).

4.2 Urban resilience

> **Papers that engage with themes of urban resilience suggest:**
>
> - Physical resilience through the provision of reliable and effective infrastructure and technology can help increase resilience at all levels, from local to national, and from rural to urban settings.
> - Urban infrastructure and technology operate as part of an overall system in which interdependencies exist, which can lead to cascading infrastructure failures if they are not addressed in an integrated way.
> - The functioning of a system and its ability to self-regulate or bounce back after a shock is important to assess the subsequent socio-economic impacts and the resilience of the system as a whole.

The papers that examine urban resilience touch upon a number of themes, the majority looking at physical vulnerability or resilience through access and provision of infrastructure and technology. Hamann et al. (2015) contrast the difference between rural and urban areas, and the transition between these two. They map 'social-ecological systems based on the direct use of ecosystem services by households' (p.214) and characterise the different systems as

'Physical resilience through reliable and effective infrastructure and technology can help increase resilience at all levels, from local to national, and from rural to urban settings (Tang et al., 2015).'

'green-loop', 'transition' or 'red-loop'. Green-loop systems correspond with rural agriculture and a dependence on the local ecosystems, whereas in 'urban industrialized or 'red-loop' systems, 'almost all individuals in society secure their basic needs for food, water and other materials through markets supplied by distant ecosystems, resulting in a society that is largely disconnected from its local environment' (p.218). The authors recognise the value of managing configurations or transitions between the two different loop systems in order to manage the particular 'resource use and human well-being challenges in different areas' (p.219). Bozza et al. (2015) also take an urban-systems-based approach, by exploring the physical and social components that comprise an urban system. The authors produce a framework to help measure urban disaster resilience, urban sustainability and efficiency, and consider different situations pre- and post-disaster to reflect on different coping and adaptive strategies, as well as the functioning of the system as a whole. The article argues that the resilience of a city 'is its capability to absorb external shocks and to reach a dynamic equilibrium', where it can respond to the needs of social actors and where the system is able to achieve the same performance post-disaster in terms of quality and efficiency.

Physical resilience through reliable and effective infrastructure and technology can help increase resilience at all levels, from local to national, and from rural to urban settings (Tang et al., 2015). Tang et al. (2015), for instance, assess the impact of the physical vulnerability of marginalised populations in rural China to earthquake activity. They recognise that as inland economies develop, urbanisation will increase and more hazard-prone land will be developed to assist the transition and expansion of cities and towns to support the 'conversion of rural communities into urban communities' (p.1113). The authors make recommendations regarding the need to improve the resilience of built systems, through better integrated basic service infrastructure and construction of dwellings. This will help to build the communities'

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physical resilience and adaptive capacity to the risk of earthquakes, and reduce the risk of increasing exposure to hazards in the future.

Urban infrastructure and technology operate as part of an overall system, which means it is important to look at the interdependencies between them (Hasan and Foliente, 2015). Hasan and Foliente (2015) do this by looking at the infrastructure system interdependencies, the possibility of cascading infrastructure failures and the subsequent socio-economic impacts. Other articles look at infrastructure relating to specific sectors; for instance, two articles look at infrastructure for water management (Mugume et al., 2015; Chelleri et al., 2015). Mugume et al. (2015) provide a methodology to analyse the performance and possible failure scenarios of urban drainage systems. Nevertheless, rather than looking at cascading failure (where a disruption in one part of the system can have ripple effects in others (Hasan and Foliente, 2015. p.201)), this article bases its goal of resilience on a system's ability to 'maintain acceptable functionality levels' and to rapidly recover after a shock; it also proposes a number of adaptation strategies to assist in this process in order to build the resilience of urban drainage systems (p.16). In addition, Chelleri et al., (2015) highlight the success of an 'integrated and sustainable decentralised water management and infrastructure plan', which has helped to achieve resilient and sustainable urban transformation in Mexico City (p.122).

Other articles reflect on urban food systems (Gilioli et al., 2014; James and Friel, 2015; and Hamann et al., 2015). Gilioli et al. (2014) for example evaluate the impact of new technology, the local economy and market conditions on farmers in poor peri-urban areas – including the role of agriculture – looking specifically at urban agriculture in Ethiopia. They assess the social-ecological system in terms of transformability and resilience, and find that the implementation of new technologies and innovation processes are essential in supporting the adaptive capacity of the farmers, who were subsequently able to diversify the type of farming modes and production systems they used, thereby helping to reduce the vulnerability of the system as a whole (p.217).

Eren and Günay's article (2015) has a slightly different focus: while it still focuses on infrastructure, it proposes an alternative land management model approach to consider the transfer of immovable property rights to build urban resilience, as opposed to looking at the physical infrastructure itself. The authors see property rights as a 'policy tool for urban resilience [which] should be examined on the basis of the relationship between partial interests in property; relative to value, land use, the location and the amount and type of real property transactions' (p.1). The land management model is consequently proposed as a strategic tool that helps to define 'space (re) production, development, protection, and management processes' for urban resilience (p.1).

4.3 Ecosystem-based adaptation and natural resource management

Papers that engage with themes of ecosystem-based adaptation and natural resource management suggest:

- Natural resource management is important to manage the risk of loss of ecosystems and land degradation, and can be achieved through a number of different practices and technologies that need to be scaled up to achieve ecosystem resilience.

- A mixture of natural and hybrid approaches to ecosystem management should be included in policies and planning in order to protect areas at risk of climate change and natural hazards.

- A transition towards decentralisation and a people-centred approach to resource management will help to foster sustainability and enhance ownership and responsibility of the natural resources in the area.

- Learning about the shifts, changes and adaptive capacity of ecosystems in the past, in terms of how resilient they are to sudden shocks or stresses, can help inform what management strategies are needed to deal with similar events in the future.

Land use management and planning

Land use management, planning and practices are themes that cross a number of the articles in the review; however, only two articles take a natural resource management approach. Maisharou et al. (2015) examine sustainable land management solutions to manage the risk of land conversion, forest loss and degradation across the Sahel, Africa. They consider different practices, techniques and technologies of sustainable land management in the Sahelian Countries, such as 'water harvesting technologies, soil fertility improvement techniques, afforestation and management of forests and protected areas' (p.16), and then how to scale up these best practices across the region (p.1). The authors also consider the different institutional, political and financial barriers and enabling environments that exist for doing so, recommending that sustainable land management practices 'should be integrated into the multi-sectoral policy frameworks in the region' (p.16). Bell and Morrison (2015), on the other hand, analyse land use planning and the governance of flood-prone areas in the state of Queensland, Australia. The paper finds that although there are challenges involved with both adaptive and precautionary governance, adaptive governance promises 'more flexibility in dealing with sudden changes, complexity and uncertainty' (p.530). The authors also acknowledge the 'political

trade-off' that exists in terms of the economic benefits that can be gained from the floodplain, which easily compensate for the relatively infrequent damages caused by flooding (p.530). The article also calls for a scaling up of adaptive modes of governance through multi-stakeholder action.

Water resource management

At the national level, Mehran et al. (2015) use a hybrid framework for assessing socio-economic drought, which is when the water supply cannot meet the demand for water. The article takes an approach that relies on taking multiple variables into account when understanding socio-economic drought and water stress. It considers a top-down methodology that assesses climatic and meteorological conditions and decision-making processes, alongside a bottom-up methodology which assesses local capacity to respond or adapt to drought and cope with water stress. The bottom-up approach consequently 'relies on the available infrastructure, institutional capacity, social conditions, and perception of water vulnerability' (p.7525). Sutton-Grier et al. (2015) also highlight a hybrid technique when they assess the strengths and weaknesses of natural ecosystem, built infrastructure and hybrid infrastructure approaches to coastal protection. The authors argue for the application of a mix of natural and hybrid approaches within coastal protection policies and planning, and recognise that many coastal communities are already implementing such approaches. They call for further research on the cost, value and co-benefits of such an approach, as well as further innovation, in order to assess 'which approaches work best in different locations and under different circumstances' (p.146), so that natural and hybrid infrastructure approaches can also be scaled up in the future (p.137). In a similar way that Sutton-Grier et al. (2015) recognise the role of the community in water resource management, two of the policy recommendations in Vedeld et al. (2015) are 'Provide the district level with a formal mandate, resources, and powers for (community-led) land development control and flood risk management' and 'Continue to enable yet greater commitment to participation of poor citizens in coproduction of relevant services and local planning' (p.24) for flood risk management in Saint Louis, Senegal. Chelleri et al. (2015) similarly take a people-centred approach for building urban resilience, adopting a transition to decentralised water resource management in neglected neighbourhoods in Mexico City, which they argue leads to greater resilience due to a 'shift in the control and management of urban resources from a central institution, to the people living in a district', which helps to foster urban sustainability (p.123).

Ecosystems

Van der Horn et al. (2015) focus on the adaptive capacity of ecosystems in terms of their resilience to deal with sudden shocks (in which a sudden ecosystem transition might take place), or minor events (in which a gradual shift or 'succession' might occur) (p.116). They use climate models and archaeological studies to look at the impacts of the 8.2ka climate event[5] on the natural environment, farmers, farming practices and subsistence opportunities of Tell Sabi Abyad, Syria, whilst also considering what other factors, such as cultural and anthropogenic, might have contributed to the resilience of ecosystems in this region. The use of archaeological records of wild plants and animal species helps the authors to look at the changes over time in terms of farming methods used; however, they were not able to ascertain with high certainty if the effects of the 8.2ka climate event were strong enough to influence subsistence strategies or cause vegetation shifts at Tell Sabi Abyad. Nevertheless, the authors stress the 'added value of archaeology for research on ecosystem resilience. Comparing archaeological datasets with ice core data and climate models can give a more complete picture of the way in which external factors affect ecosystems and the differences between ecosystem tipping points throughout different regions in the world' (p.117). Rocha et al. (2015) take a similar approach to looking at ecosystem management and service opportunities by considering historical changes to the regime shifts in the Anthropocene. The article compares regime shifts and their drivers across a number of different systems, in order to share lessons and to look for different ecosystem management/services opportunities. It also considers the 'potential for cascading effects among multiple regime shifts' (p.9), as well as how these can be managed. The authors found that the most frequently co-occurring drivers are 'agriculture, climate change, nutrient inputs, deforestation, greenhouse gases, erosion and sea surface temperature' (p.7). They argue that the ecosystem type has a strong influence on the 'variety of regime shift drivers as well as ecosystem services impacted by regime shifts … [and that] [a]lmost two thirds of the identified regime shift drivers (62%) have the potential to be managed at local or national scales, while a third (38%) can only be managed internationally' (p.8). In a similar way to Rocha et al. (2015), who look at drivers, Richter and Dakos

'Assessing patterns in 'trade flows, commodity prices, energy consumption, or fisheries profits, might reflect the social-ecological resilience of such systems and the likelihood of approaching a critical transition in the ecological part of these systems' (Rocha and Dakos, 2015; 20)'

(2015) examine the 'anticipation and management of tipping points', transitions and transformations in social-ecological systems (SES) by using early warning systems that assess patterns in socio-economic development. For instance, assessing patterns in 'trade flows, commodity prices, energy consumption, or fisheries profits, might reflect the social-ecological resilience of such systems and the likelihood of approaching a critical transition in the ecological part of these systems' (p.20).

It is also important to mention that a number of articles refer to natural resource dependency on different types of ecosystems. Cinner et al. (2015) consider the changes in adaptive capacity of fishing communities in Kenya that are heavily dependent on natural resources for their livelihoods. They demonstrate that access to credit and community infrastructure has helped to enhance aspects of adaptive capacity within the community between 2008 and 2012; however, they also highlight that there may be 'different needs between (for example) younger and older people; migrants and non-migrants; and those already involved in decision-making and those that are not' (p.4). Furthermore, Salik et al. (2015) explore the 'climate change induced socio-economic vulnerability of mangrove-dependent communities in the Indus Delta' in Pakistan (p.61). Finally, Hamann et al. (2015) contrasts rural 'green-loop' systems, where people are dependent on different local ecosystems, with urban industrialized or 'red-loop' systems, where people are dependent on markets, 'supplied by distant ecosystems' where buyers are almost entirely disconnected from the local environment in which the goods are produced (p.218).

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5   The 8.2 ka event was 'first discovered in the Greenland ice core GISP2, where high-resolution analyses indicate that over two decades temperature cooled about 3.3°C in Greenland (Alley et al., 1997; Kobashi et al., 2007). The entire event lasted about 150 years (Thomas et al., 2007; Kobashi et al., 2007) and then temperatures warmed, returning to their previous levels' (NOAA, 2008). The effects of the '8.2 ka event were of a global scale, but were strongest in the northern hemisphere (Wiersma, 2008). In general, annual temperatures decreased all over the northern hemisphere, while some places, mainly in Africa and Asia, became drier (Alley and Agústdottir, 2005)' (van der Horn et al., 112).

4.4 Agriculture and livelihoods

Papers that engage with themes of agriculture and livelihoods suggest:

- Climate change and natural hazards impact agroecological systems differently, and therefore a variety of context specific adaptation strategies and policies are needed to build the resilience of agricultural practices.

- Climate-smart agriculture, technology and innovation are all key to building the adaptive capacity and resilience of farmers and social-ecological systems that support agricultural practices.

- An integrated approach is needed across scales and sectors to build the adaptive capacity and resilience of the food system and food chain (from the production, distribution and consumption of produce and goods).

- Analysing past and current coping strategies and the adaptive capacity of different communities to natural hazards can help practitioners and policy-makers consider the drivers of change and how these have contributed to livelihood resilience and a community's ability to cope with and respond to such an event.

Climate-smart agriculture and farming practices

Bendito and Twomlow (2015) and Arslan et al. (2015) both discuss climate-smart agricultural practices within their articles. Bendito and Twomlow (2015) promote climate-smart approaches to post-harvest challenges in Rwanda. They recognise the impact of climate change on development investments and on the infrastructure that is used for post-harvest storage and processing, and they examine the strengths and weaknesses of these structures. The authors recognise that although the structures from the study are still standing, building codes have not been enforced, and there has not been a disaster recently to test the structures. They suggest a set of guidelines and recommendations for the post-harvest structures and call for a holistic approach 'consisting of creation of public awareness, education and training, research and development about safety from natural hazards' (p.238). Arslan et al. (2015) use household panel data from the Rural Incomes and Livelihoods Surveys (RILS) along with a set of climatic variables and soil characteristics to assess the impacts of climate-smart agriculture and the adaptation implications on maize yields in Zambia. The results demonstrate that climate change impacts agroecological systems differently, thereby underlining the need for varied adaptation strategies and policies that are context and site specific in order to effectively improve the resilience of smallholder agriculture in Zambia in the face of climate change (p.754). Conversely, van der Horn et al. (2015) use historical data through archaeological studies and climate models to consider the impacts of the 8.2ka climate event on the natural environment, farmers, farming practices and subsistence opportunities of Tell Sabi Abyad, Syria, as discussed previously.

Altieri et al. (2015) also examine agroecological practices in terms of how they impact the resilience of farming systems in the face of climate change. They consider social networks and collective strategies as a means for enhancing the adaptive capacity and resilience of farmers to 'deploy agroecological mechanisms that allow [them] to resist and/or recover from climatic events' (p.886). The authors

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consequently explore the differences that exist between traditional communities and large-scale farms, and find that in contrast 'large-scale farms have a low capacity to respond to changes in environmental conditions, because in the regions that they dominate the social fabric has been broken' and therefore their adaptive capacity is limited (p.886-7). The authors recognise that lessons about where agroecological practices have been successful could be communicated to thousands of farmers through the Campesino a Campesino networks, which would help to scale up these practices and build the resilience of agroecosystems in the region (p.870). In another article, Gilioli et al. (2014) focus on the role of technology and innovation in building the adaptive capacity of farmers and the resilience of the social-ecological system for urban agriculture in peri-urban areas of Ethiopia.

Food production

James and Friel (2015) take a 'whole-of-food system' perspective that investigates the food chain in terms of production, distribution and consumption (p.2499). They counter the assumption of 'going "local" and rejecting the industrial food system', and call for integrated action across scales and sectors to build the adaptive capacity and resilience of such systems. They highlight that 'a resilient urban food system requires that healthy and sustainable food items are produced, that consumers can attain them and that they actually wish to purchase them' (p.2498). Hamann et al. (2015) take a similar approach in their article that maps social-ecological systems from the 'green-loop' or rural agricultural systems and the 'red loop' or urban industrialised systems (p.218). Whilst recognising that both systems have different advantages and sustainability challenges, the authors argue that the 'social–ecological interactions they represent may take us a step further to mapping systems that have direct policy and decision-making relevance for sustainable resource management and land use planning' (p.225).

'A resilient urban food system requires that healthy and sustainable food items are produced, that consumers can attain them and that they actually wish to purchase them.'

Livelihoods

Three articles look specifically at the coping and adaptive strategies of coastal communities in Brazil (Prado et al., 2015), Pakistan (Salik et al., 2015) and Kenya (Cinner et al., 2015); while another looks at the strategies of subsistence farmers in Uganda (Cooper and Wheeler, 2015). Prado et al. (2015) consider the past coping and adaptive strategies used to respond to social and ecological changes over time, using the case study of a coastal community in Brazil. Using a livelihood pathway analysis, they consider drivers of change, gains and trade-offs to changes in social-ecological systems, and how these have contributed to livelihood resilience. The authors reflect on how past coping strategies have 'shaped the current system' and what effects this might have on/for future change, particularly in the face of weakening social cohesion (p.30). Salik et al. (2015) find that the coastal communities who are engaged in the fishery or agricultural sector on the Indus delta in Pakistan are exposed to, and at risk from, climate related events. In addition, '[lack of access to] basic facilities, inadequate income diversification, and low education levels are negatively affecting the adaptive capacity of the entire local population' (p.61). However, conversely to Prado et al. (2015), Salik et al. (2015) find that the 'communities' nature of dwelling, their strong family networks, and their ability to migrate contribute positively to their adaptive capacity' to prepare for and respond to climatic events (p.61). Cinner at al. (2015) examine nine indicators of adaptive capacity to assess the ability of coastal communities in Kenya to cope with climate change. They found that during the study period of 2008-2012, adaptive capacity appeared to have increased 'owing to higher observed community infrastructure and perceived availability of credit' (p.1). Cooper and Wheeler (2015) on the other hand take a more macro approach, providing an example of where adaptive governance can be used to promote resilient livelihood outcomes 'among rural subsistence farmers within a decentralised governing framework' in Uganda through a number of processes including 'learning platforms [that help with] promoting knowledge transfer leading to improved self-efficacy, innovation and livelihood skills' (p.96).

4.5 Framing and measuring resilience

Papers that present insights on framing and measuring resilience suggest:

- The term 'transformation' is useful as an analytical concept if it is used in a robust and rigorous way, but it is important to 'resist the fashion of transformation, i.e., the temptation of attributing a transformative character to any instance of social change' (Feola, 2014: 387).
- Measuring resilience, vulnerability and adaptive capacity is essential in order to understand the coping and adaptation strategies of different individuals and communities and the functioning and return time of different systems after a disaster.
- It is possible to identify patterns and compare places that have similar vulnerabilities in order to help connect communities and to enhance networking, learning and cooperation in building resilience.

There are a number of articles that consider adaptive capacity, transition and transformation for building resilience, with some considering drivers, tipping points and the trade-offs which exist. These concepts are assessed at different scales from the local to the national level, while more than 10 of the articles take a systems-based approach. At the macro level, Abiad et al. (2015) examine the economic performance in emerging market and developing economies (EMDEs), looking at their resilience to external and domestic shocks. In this context, the paper considers resilience as the EMDEs' 'ability to sustain longer and stronger expansions [or positive growth], and to experience shorter and shallower downturns and more rapid recoveries' in the face of shocks and stresses (p.1). Abiad et al. (2015) conclude that EMDEs are generally doing better because 'the frequency of economic shocks has fallen' (p.21) and economies have diversified with stronger policy frameworks in place. Nevertheless, they highlight the transition and path that Advanced Economies have taken, and suggests that EMDEs still need to have adequate and flexible policies in place (for instance 'greater exchange rate flexibility and more countercyclical macroeconomic policies' (p.21)) in order to guard against such shocks (p.1).

Ten articles also explicitly consider social-ecological aspects of resilience and transformation. For instance, Feola (2014) considers societal transformation in both reactive and active response to global environmental change. In this article, Feola (2014) provides eight different concepts of transformation used in the literature (shown in the figure below) and then critically examines whether the term 'transformation' is useful as an analytical concept, or whether it is being used as a 'buzz-word' or metaphor that is too vague, leading to confusion and a dilution of the meaning. The author argues that there is '[more to] gain than to lose in taking a rigorous, substantial use of transformation as an analytical concept' but stresses the need to 'resist the fashion of transformation, i.e., the temptation of attributing a transformative character to any instance of social change' (p.387).

Figure 23: Concepts of transformation most often employed in the literature. Overlaps denote concepts that at times are found to be employed concomitantly

SOCIAL PRACTICE
Shove et al. (2012)

SOCIETAL TRANSITIONS
Grin et al. (2010)

SOCIOECOLOGICAL TRANSITION
Fischer Kowalski and Habert (2007)

REGIME SHIFT
Walker et al. (2004)

PROGRESSIVE TRANSFORMATIONS
Pelling (2011)

DELIBERATE TRANSFORMATIONS
O'Brien (2012)

TRANSFORMATIONAL ADAPTATION 2
Park et al. (2012)

TRANSFORMATIONAL ADAPTATION 1
Kates et al. (2012)
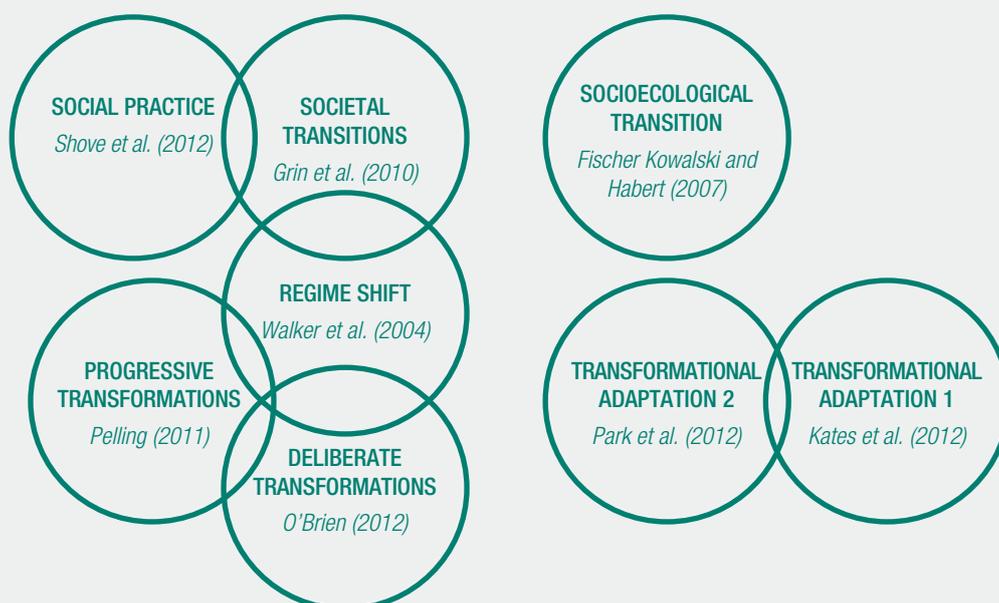
Measuring resilience

Measuring resilience, vulnerability and adaptive capacity is a common theme in almost a third of the articles reviewed. Hodgson et al., in their article What do you mean, 'resilient'? (2015), define the measurement of resilience by resistance and recovery time; analysing resistance, elasticity, change in state and return time amongst other factors. The approach considers whether a system is self-regulating, in that it looks at whether we 'want' a system that 'resists disturbance, recovers quickly, or avoids tipping points … [whilst recognising that p]ervasive trade-offs might prevent achievement of all three' (p.505). Two other articles look at this idea of self-regulating. Bozza et al. (2015) examines urban systems that are modelled as hybrid social–physical networks (HSPNs). The article attempts to quantify the resilience of such systems against disasters, whilst considering their different coping and adaptive strategies, the functioning of the system pre- and post-disaster, and its ability to reach a dynamic equilibrium after a shock (p.1731). Meanwhile, Mugume et al. (2015) also examine urban areas, analysing, as we have seen previously, the resilience of urban drainage systems, through a Global Resilience Analysis (GRA) approach, which assesses the systems performance, the different scenarios for failure within the system, and its ability to maintain an 'acceptable functionality level' after a disaster (p.16).

Other articles in the review measure the resilience, vulnerability and adaptive capacity of people at risk of disasters. Chang et al. (2015), for instance, suggest a similarity-based approach for assessing vulnerability to disasters, through quantitative indicators, using the Hazard Vulnerability Similarity Index (HVSI) – which is broken down into a number of capitals (economic, social, built and natural), and then by indicator and variable. This approach enables the authors to identify patterns and compare places that have similar vulnerabilities in order to help connect communities, and enhance networking, learning and cooperation in building resilience. The authors suggest that this type of approach could hugely benefit the effectiveness of networks such as the 100 Resilient Cities initiative, as a filter such as the HVSI could be applied to 'help communities that are similar to connect with one another' (p.1838). Alshehri et al. (2015) propose a framework that uses the Delphi method for measuring community resilience to disasters in Saudi Arabia. It focuses on six key dimensions: health and well-being, governance, physical and environmental, economic, information and communication, and social; each of which are given a different weighting. The data can then be used to measure different individuals' and groups' socio-economic, cultural, political and geographic vulnerabilities and capacities, which can then be built upon to strengthen their resilience. The authors propose that further research is needed to validate the weightings, and have consequently proposed to test the framework at Hajj. Salik et al. (2015) use a Composite Vulnerability Index (CVI) to measure the socio-economic vulnerability, exposure, sensitivity and adaptive capacity of people living on the Indus delta in Pakistan who are at risk of climate change and related events. Cinner et al. (2015) use nine indicators to measure the adaptive capacity of coastal communities in Kenya: 'human agency; access to credit; occupational mobility; occupational multiplicity; social capital; material style of life; gear diversity; community infrastructure; and trust' (p.1). They collect disaggregated data, using these indicators to assess the differences in adaptive capacity between different individuals and groups, whilst also examining adaptive capacity over time; the results are discussed briefly in the section above on livelihoods. As we have already seen, Prado et al. (2015) use a livelihood pathway analysis to examine the past coping and adaptive strategies used to respond to social and ecological changes in a coastal community in Brazil, as well as what impact these strategies might have for future change. And finally, van der Horn et al. (2015) use a different approach to assess the historic adaptive capacity of ecosystems over time, through the use of archaeological studies and climate models.

'Prado et al. (2015) use a livelihood pathway analysis to examine the past coping and adaptive strategies used to respond to social and ecological changes in a coastal community in Brazil, as well as what impact these strategies might have for future change.'

5. Understanding the characteristics of resilience

As is evident from the preceding sections, multiple disciplines and domains of practice employ resilience thinking. This section therefore draws out connections across the growing field of resilience to understand the directions in which the field is moving. This section interprets the literature discussed in the scans of academic and grey literature based on five characteristics of resilient systems identified by the Rockefeller Foundation. These characteristics have been distilled through a consideration of a wide body of research on the topic.

5.1 Awareness

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:

- The use of robust data, monitoring and evaluation is key for raising awareness and building a greater understanding of what strengths, weaknesses and risks exist within a given context and therefore what is needed to help build resilience to natural hazards and disasters.
- Collecting resilience information at a high frequency is key for improving situational awareness, which requires data from both big data streams and smaller, crowd-sourced data or surveys.
- Community and public awareness about risks and threats is essential for informing adaptation planning and building resilience.

Measuring vulnerability, capacity and resilience is key for raising awareness about what different strengths and weaknesses exist within a given context. Although awareness as a theme is prevalent throughout the academic and grey literature, only one of the reports in the grey literature explicitly frames the importance of

collecting data in this way. The peer-reviewed journal literature addresses the need to be aware of the local context, and examines how this information can be used and tailored to inform policies and practices that are specific to the evolving social-ecological environment within which they are set. The peer-reviewed journal literature also raises the theme of awareness systematically, with community and public awareness explored in numerous articles.

Recent working papers from the Food Security Information Network and ODI delve into alternative methods of collecting resilience-related information. Subjective resilience is a prominent theme, as is collecting information at multiple scales – temporal and spatial – to inform systems thinking. The article *Systems analysis in the context of resilience* recommends conducting high frequency measurement of resilience information for 'situational awareness', which is particularly important around shock events and in the face of known stresses. This requires vigilant monitoring of multiple streams of data, including satellite data to track changes in ecosystem variables, SMS-based or survey-based data on coping behaviours and food consumption, and crisis mapping using crowdsourced methods (Mock et. al. 2015). Using diverse variables to illustrate a better idea of the system underpinning resilience can contribute to better awareness.

On the whole, the grey literature highlights that awareness is not only about what is known, but who knows it. The articles stress that improving stakeholder collaboration when designing vulnerability assessments

'The grey literature highlights that awareness is not only about what is known, but who knows it.'

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and climate action plans can improve the baseline awareness of risks and identify early solutions (Taylor and Lassa, 2015). However, even when this information has been collected in a participatory manner, from community to national levels, it often falls short of uptake in policy and government planning across sectors because it is not in the hands of those who are formulating policy or making budgetary decisions. This point has considerable overlap with integration, and is addressed in more detail in that section.

Almost a third of the articles in the peer-reviewed journal literature look at measuring resilience, vulnerability or adaptive capacity. This helps support awareness about what different vulnerabilities, weaknesses, strengths and capacities exist, and therefore what is needed to build resilience to natural hazards and disasters.[6] For instance, Salik et al. (2015) measure the socio-economic vulnerability of people living on the Indus delta in Pakistan, considering what their exposure, sensitivity and adaptive capacity is like in responding to climate change and related events. A number of the articles also focus on the need to be aware and tailor tools and practices to the local context, as vulnerabilities and risk are 'place-based and context specific' (Wongbusarakum et al., 2015: 391; Arslan et al., 2015). This kind of approach recognises the importance of being aware that individuals, communities and systems may have different socio-economic, cultural, political and geographic characteristics or structures which can either enhance their vulnerabilities or resilience to disasters (Alshehri et al, 2015). Conversely, a few of the articles use comparative studies or a similarity approach in order to identify patterns and compare places that have similar strengths, vulnerabilities, threats and/or risks. This is the approach used by Chang et al. (2015), which, they argue, helps to connect communities and to enhance networking, learning and cooperation to build resilience.

'Measuring resilience, vulnerability or adaptive capacity; which helps support awareness about what different vulnerabilities, weaknesses, strengths and capacities exist, and therefore what is needed to build resilience to natural hazards and disaster.'

6   For specific examples please see the 'Measuring resilience' section in the peer-reviewed journal literature section.

Community and public awareness about different risks and threats is a theme raised in numerous articles. For instance, Wongbusarakum et al. (2015) and Webb et al. (2015) look at building community awareness around climate risks and climate information in order to inform adaptation planning. Risk awareness and training are also explicitly included as one of the criteria under the social dimension of the framework used to measure community resilience in Alshehri et al. (2015). Furthermore, Bendito and Twomlow (2015) explicitly mention awareness within their recommendations, stating that the 'development of risk maps can have a number of beneficial impacts, such as increasing general public awareness of natural hazard, urban planning, selecting sites for important facilities (e.g. hospitals and schools), providing a basis for whether site-specific hazard evaluations should be performed, aiding emergency preparedness and response, and loss estimation' in Rwanda (p.237).

Some of the studies use methods for information gathering that include monitoring systems over time to raise awareness. For instance, Bronen (2015) uses a social-ecological monitoring tool to determine whether and when community climate-induced relocation is needed, in order to help guide sustainable adaptation strategies accordingly; Mehran et al. (2015) use a hybrid framework to measure socio-economic drought, which combines 'information on the inflow and reservoir storage relative to the demand' (p.7520); and Richter and Dakos (2015) attempt to anticipate and manage tipping points, transitions and transformations in social-ecological systems (SES) by assessing patterns in socio-economic developments (for instance changes in trade flows, commodity price fluctuations, etc.). These longitudinal monitoring or information gathering techniques recognise the fact that '[b]eing aware is not a static condition; it's the ability to constantly assess, take in new information, reassess and adjust your understanding of the most critical and relevant strengths and weaknesses and other factors on the fly' (Rockefeller Foundation, 2015).

'Because household resilience involves both covariate risks, such as floods, and idiosyncratic risks, such as sickness, a diversity of information sources can capture not only who is more resilient but why they are more resilient than others.'

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 every-day functioning or relying on only one element for a given purpose.

Key messages:
- Collecting information from a wide range of diverse sources is emphasised heavily in the grey literature on monitoring and evaluation.
- The diverse nature and characteristics of different systems and ecosystems need to directly inform policy and decision-making processes.
- Diversity is implicit in the range of skills and capacities that people can use to prepare for and respond to disasters.

Diversity as a characteristic of resilience is addressed explicitly in the grey literature in regards to collecting diverse data for M&E purposes. FSIN's recent working papers advocate for collecting a diversity of information (and from a diversity of sources) to more holistically understand all the subsystems and social-ecological networks that affect resilience. This speaks to the idea that 'being diverse means systems can draw upon a range of information sources', and is recommended in two FSIN publications: *Household data sources for measuring and understanding resilience* and *Measuring shocks and stressors as part of resilience measurement*. Because household resilience involves both covariate risks, such as floods, and idiosyncratic risks, such as sickness, a diversity of information sources can capture not only who is more resilient but why they are more resilient than others. Because resilience defies easy quantification, combining multiple sources of information is necessary – albeit challenging – for capturing all the dimensions of resilience (Carletto, 2015). One idea that is mentioned multiple times across articles is establishing a rigorous longitudinal resilience-related study in a few key locations around the world. This can avoid the pitfalls of mining secondary data for resilience indicators, and allows subjective indicators to be built into surveying methods. Such a system could be designed to conduct rapid and frequent data collection – key for a stronger understanding of how risks and disturbances impact resilience over time.

Numerous articles within the peer-reviewed journal literature consider aspects of diversity, though more implicitly than explicitly. Some articles take a systems-based approach, which recognises the diverse nature of different systems, as well as the 'range of capabilities, information sources, technical elements, people or groups' that are involved (Rockefeller Foundation,

2015). Hamann et al. (2015), for example, explicitly acknowledge the diversity that exists across social-ecological systems, and the range of challenges and dependencies that each system encounters as a result. The article reflects that it is essential to map the location, type of systems, dynamics and characteristics in order to have 'direct policy and decision-making relevance for sustainable resource management and land use planning' (p.225). Similarly, as mentioned in the previous category, Richter and Dakos (2015) attempt to anticipate and manage tipping points, transitions and transformations in SES by assessing patterns and early warnings from socio-economic developments (for instance, changes in trade flows, commodity price fluctuations etc.). In another example, Rocha et al. (2015) compare diverse regime shifts and their drivers, which they recognise will help broaden 'our understanding of regime shift similarities at the conceptual level while offering the possibility to translate the observed patterns into useful management insights' (p.11).

A number of the articles look explicitly at the diversity of natural ecosystems, in terms of the 'diversity of economically and ecologically important fauna and flora (Walters et al., 2008; Valiela et al., 2009) providing livelihoods for dependent communities' (Salik et al., 2015: 61); or in terms of the need for a diversification of farming and agriculture practices/techniques or livelihood/income diversification in order to enhance adaptive capacity and resilience (Gilioli et al., 2015; Arslan et al., 2015). Others consider diversity in terms of natural resource management; for instance, Sutton-Grier et al. (2015) examine natural ecosystem, built and

'Map the location, type of systems, dynamics and characteristics in order to have 'direct policy and decision-making relevance.'

hybrid infrastructure approaches to coastal protection, and recognise that 'hybrid approaches are growing in number with a diversity of approaches providing exciting new opportunities for cities and communities to plan for and adapt to changing sea levels while reaping co-benefits like recreational opportunities and greener urban living options' (p.145).

Diversity is also implicit in the range of capacities that people can use to prepare for and respond to disasters. Cinner et al. (2015) collect socially disaggregated data, so as to assess the different vulnerabilities, capacities and resilience of different individuals and groups within a fishing community in Kenya that is at risk of climate change. Salik et al. (2015) recognise the negative and positive aspects that contribute to people's adaptive capacity at the household level in coastal communities in Pakistan. Sadiq and Noonan (2015), on the other hand, highlight different characteristics, motivations and behaviours of various communities that responded to a top-down incentive scheme aiming to build community flood risk mitigation. Other articles call for the participation of a diverse range of people, groups and organisations to enhance adaptive capacity and resilience (Vedeld et al., 2015; and Bronen, 2015).

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5.3 Self-regulation

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

Key messages:

- The different stages that take place in the process of self-regulation are referred to using the terms tipping-points, change in state, resistance and recovery time within the peer-reviewed journal literature.
- The possibility of cascading disruptions due to interdependencies within a system, demonstrating a lack of self-regulation, is discussed in the peer-reviewed journal literature.
- Social protection programmes feature as a mechanism to support self-regulation for the poorest, though self-regulation is addressed only implicitly in the grey literature.

Self-regulating covers a broad range of topics in this resilience scan, both implicitly and explicitly. Within the grey literature, it is addressed implicitly in regards to social protection programmes and how these can complement ongoing climate change adaptation and disaster risk reduction activities. While none of the articles in the peer-reviewed journal literature explicitly mention the term 'self-regulating', the term 'self-organisation' is used a number of times. The peer-reviewed journal literature also examines what happens if a system is not able to self-regulate, and where 'cascading' failure is possible.

Within the grey literature, 'self-regulating' is addressed implicitly, and primarily at the micro level. Social protection programmes are gaining favour as a policy solution for poor households with little capacity to withstand disruption, particularly for the rural poor who depend on agricultural production that is increasingly exposed to floods and droughts. By providing direct cash transfers or public work programmes that create assets and provide livelihood support in times of duress, social protection programmes can create a buffer space for the poorest to avoid 'failure' or 'extreme malfunction' that could prevent or delay full recovery. The World Bank (2015) and CARE (2015) both suggest that social protection be tied to early warning triggers, particularly for households that face chronic food insecurity. Social protection prevents overreliance on emergency humanitarian aid. These articles advocate for better integration between DRM and social protection policy given their shared aim of supporting resilience against shocks and stresses for the most vulnerable.

A number of articles in the peer-reviewed journal literature consider 'self-regulating' systems, as well as the different stages that take place during the process of self-regulation. Hodgson et al. (2015) for instance define the measurement of resilience by looking at resistance and recovery time, elasticity, 'change in state' and return time, amongst other factors. The approach considers whether a system is self-regulating by looking at whether a system 'resists disturbance, recovers quickly, or avoids tipping points' (p.505). Similarly, Abiad et al. (2015) consider the economic performance and the 'duration of expansions and the speed of recovery' of emerging markets and developing economies (p.1).

In contrast, a few articles look at the possibility of cascading disruptions due to an interdependency within systems, demonstrating a lack of self-regulation within the system. For instance, Hasan and Foliente (2015) consider different infrastructure interdependencies particularly in urban areas, looking at the possibility of cascading infrastructure failures whilst also recognising that different stakeholders have different primary decision goals and contexts that need to be addressed in order to deal with these challenges. Mugume et al. (2015) look at the different possible scenarios for structural failure and random cumulative link failure within urban drainage systems.

Although no articles use the term 'self-regulation', a number of them use 'self-organisation'. For instance, Prado et al. (2015) states that 'the social-ecological system showed self-organization and political agency... which contributed to resilience building' (p.36); Gilioli et al. (2015) use 'self-organisation capacity' as a component for measuring the resilience of a system; and Altieri et al. (2015) and Cooper and Wheeler (2015) include the capacity for self-organisation within their definitions of resilience and resilient systems. Other articles look at bouncing back after a disaster, as opposed to self-regulating. For instance, Bozza et al. (2015) consider what happens when a city/ecosystem reaches a dynamic equilibrium, where it can respond to the needs of social actors, and where the performance of the system matches the pre-disaster state in terms of efficiency and quality.

'A few articles look at the possibility of cascading disruptions due to an interdependency within systems, demonstrating a lack of self-regulation within the system.'

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5.4 Integration

Being integrated means that individuals, groups, organizations 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:

- Integration is meaningless without 'shared information' being taken up in policy and accounted for in budgets.
- Horizontal and vertical integration between individuals, groups and organisations, as well as across sectors and scales is essential for building resilience to climate extremes and disasters.
- Collaborative communication and the use of integrated knowledge can help facilitate greater effectiveness and co-ownership of tools, practices and policies and better ways of working.

The grey literature explicitly recognises the value of the integration of diverse groups, policies, and plans to enhance resilience, stressing the importance of linking resilience related vulnerability assessments to concretely influencing legislation and budgets. In the Asian Cities Climate Change Resilience Network's recent work on resilience in cities, two working papers explicitly address how not only to build ownership over resilience processes amongst stakeholders at the community and national levels but to better integrate them into policy. Taylor and Lassa (2015) stress how the creation of specific institutional arrangements,

such as ACCCRN's City Team (a team of a variety of municipal government officials involved in various sectors affected by climate risks), can build ownership for resilience outcomes and move beyond raising awareness to actually influencing government strategy and plans. Similarly, an assessment of Climate Action Plans in Vietnam found that the absence of a specific mechanism to plan for and budget for recommendations resulted in inaction even for decisions that had been made with the engagement of a wide variety of stakeholders (Nyugen et al, 2015). Collecting information in a participatory manner, through a vulnerability assessment or climate action plan, is not sufficient to embed decisions into government planning across sectors. Integration is not only about bringing many perspectives together, but about embedding their collective knowledge into policy and ensuring that sufficient funding is available to implement their recommended actions.

'Integration is not only about bringing many perspectives together, but about embedding their collective knowledge into policy and ensuring that sufficient funding is available to implement their recommended actions.'

'In strongly coupled social–ecological systems there is an opportunity to identify ecological shifts based on information coming from other sources than monitoring the ecological system itself'

The peer-reviewed journal literature consistently refers explicitly and implicitly to the importance of the integration of individuals, groups, organisations and other entities in order to strengthen resilience. Integration within governance, politics and systems is a strong theme within this review. For instance, James and Friel's article (2015) is entitled: *An integrated approach to identifying and characterising resilient urban food systems to promote population health in a changing climate*. This article takes a whole-of-food system perspective and carries out an integrated analysis of the production, distribution and consumption sectors of the food chain and urban food system in Sydney (p.2498). In the article, the authors call for integrated action across scales and sectors to build the adaptive capacity and resilience of such a system. Richter and Dakos (2015)'s article also takes an integrated systems-based approach when they look at anticipating and managing tipping points, transitions and transformations in social-ecological systems (SES). The results from the article imply that in 'strongly coupled social–ecological systems there is an opportunity to identify ecological shifts based on information coming from other sources than monitoring the ecological system itself' (p.20).

Integration across sectors and scales was also prioritised in the peer-reviewed journal literature. Maisharou et al., (2015) explicitly mention integration in their recommendation that sustainable land management (SLM) practices in the Sahel 'should be integrated into the multi-sectoral policy frameworks in the region since SLM programmes are usually cross-sectoral in nature' (p.16). In a similar way, Vedeld et al., (2015)'s study of Saint Louis, Senegal, looks at whether flood risk management and adaptation have been integrated into multi-level and multi-sectoral governance in urban areas. While in Tang et al., (2015)'s article on rural china, they recommend that integrated approaches are adopted on 'education, employment, social security, health care, resource consumption tax, transfer payments on resource conservation, and construction of dwellings' in order to promote the adaptive capacity of rural communities who are at risk

of earthquake activity (p.1). Additionally, in a review that considers the interrelationships between adaptation and mitigation, Landauer et al., (2015) consider the drivers and synergies for the interrelationship between the two, and call for 'integrated climate policy-making and planning practices' (p.506). Cooper and Wheeler (2015) highlight the need for integration implicitly in their article about livelihood innovation for climate resilience in Uganda. They look at multi-stakeholder engagement, collaboration and learning, alongside the need for leadership, innovation and the importance 'of mainstreaming adaptation alongside existing policy trajectories; highlighting the significance of collaborative spaces for stakeholders and the tackling of inequality and corruption' (p.96). Conversely, Islam and Walkerden (2015) provide an example of where integration has not been hugely successful in a project that considers social networks in Bangladesh. The authors find that regardless of the communities' priorities, NGOs concentrated more on response and relief, rather than on preparedness, risk reduction, recovery, and resilience, thereby presenting a limited integration approach to disaster resilience. Other articles also offer insights into where integration efforts have not been successful, for instance Hasan and Foliente (2015)'s article highlights the 'lack of appropriate integrated approaches to assess the broad socioeconomic impacts of disruptions to interdependent infrastructures' (p.2161)

An example of where an integrated approach has been successful can be demonstrated by the method taken by six NGOs in Vanuatu who formed a partnership to look at the challenges, tools, best practice and ways of working for community-based adaptation (CBA) (Webb et al., 2015). In co-designing the tools, sharing ideas and communicating across the consortium, the article demonstrates how a Community Resilience Framework can provide a shared vision for partners resulting in improved collaboration' and co-ownership of tools and approaches (p.410). Similarly, Chang et al., (2015) suggest using a similarity-based approach for assessing vulnerability to disasters, which they propose could help to develop the effectiveness of resilience networks such as The 100 Resilient Cities initiative of the Rockefeller Foundation, as the index could help connect communities that experience similar risks. In another article, Wongbusarakum et al., (2015) discuss the need to incorporate science and local knowledge in community planning and decision-making, recognising that it is this 'integrated knowledge that creates ownership of the adaptation process and empowers communities to draw on their existing capacity to adapt (McNaught, Warrick, and Cooper 2014)' (p.384).

5.5 Adaptiveness

The capacity to adjust to changing circumstances during a disruption by developing new plans, taking new actions or modifying behaviours so that 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. Adaptability also suggests flexibility, the ability to apply existing resources to new purposes or for one thing to take on multiple roles.

Key messages:

- 'Adaptiveness' is not mentioned explicitly in the grey literature, aside from a new M&E framework that defines 'resilience-related capacities' – anticipatory, absorptive, and adaptive.
- Adaptive capacity is a prominent theme within the peer-reviewed journal literature, which assesses the adaptive capacity of communities, ecosystems and urban systems.
- Social cohesion and family/social networks make a strong contribution to adaptive capacity.
- Adaptive governance is important for managing the diversity and complexity of social-ecological systems.

Although adaptive capacity pervades much of the discourse on resilience, it does not feature heavily in the grey literature, nor is it explicitly mentioned. It is recognised as an important component of resilience in Bahadur et al.'s 3As framework (2015), in which resilience is broken down into three distinct but interrelated capacities – anticipatory, absorptive, and adaptive. Adaptive capacity is defined as the ability to learn from shocks and stresses and build back better, as well as to plan for long-term changes. However, Rockefeller's working definition of 'adaptive' also incorporates dimensions of anticipatory capacity, particularly in regards to cities and systems being 'prepared to respond quickly to extreme events'. One report by IIASA and Zurich presents a toolkit for assessing and managing flood risk, advocating for the use of a modified adaptive management cycle to manage flood impacts and risks. An adaptive approach allows for stakeholders to continually refine understanding of how development interacts with flooding risks. The adaptive component of the programme is based on the idea that resilience is not a one-off action but a continuous process that requires learning.

Adaptive capacity is a prominent theme throughout the peer-reviewed journal literature. It is recognised as an important factor at different levels; for instance, a number of the articles look at adaptive capacity at the community level, whereas others take a more systems-based approach either looking at the adaptive capacity of natural ecosystems (van der Horn et al., 2015; Rocha et al., 2015) or the adaptive capacity, transition or even transformation that is taking place within urban systems. Cinner et al.'s article, *Changes in adaptive capacity of Kenyan fishing communities* (2015), and Salik et al.'s article, *Climate change vulnerability and adaptation options for the coastal communities of Pakistan* (2015), both look at the adaptive capacity of coastal communities who rely on the fishery or
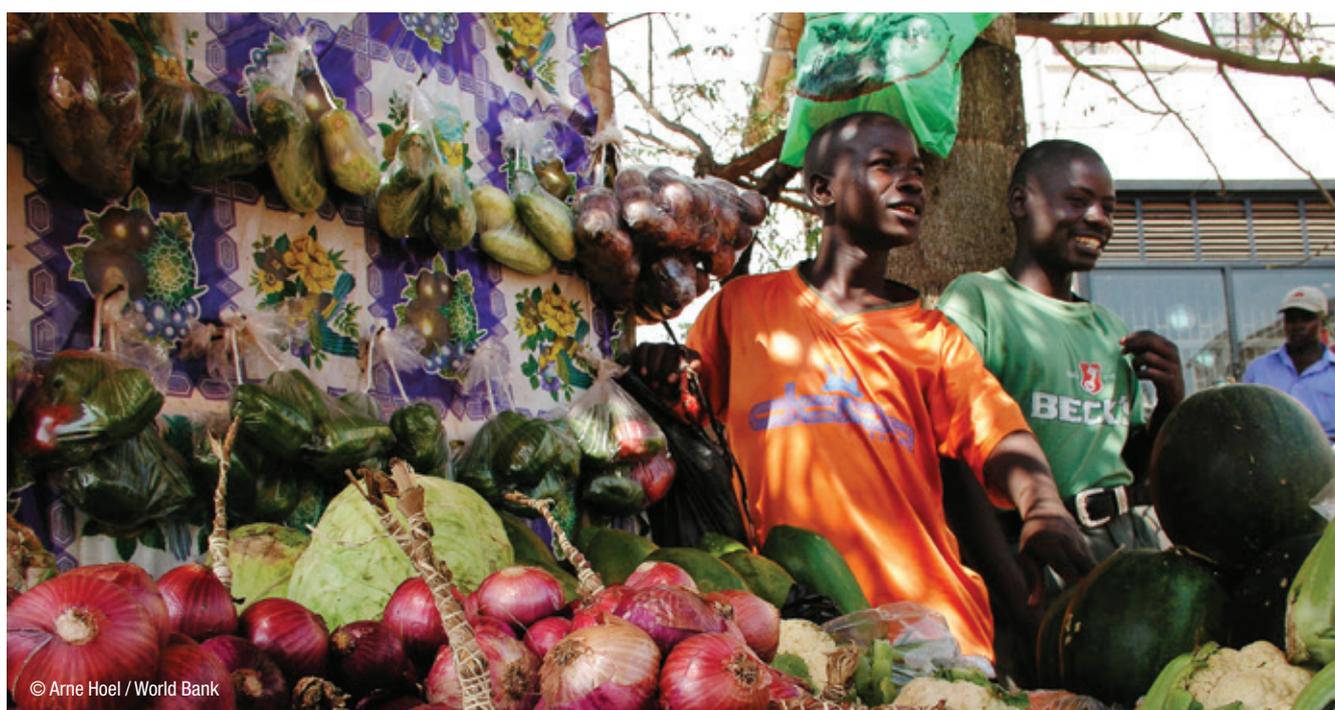
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> ### 'Social cohesion and family/ social networks were also seen as a strong contribution to adaptive capacity.'

agriculture sector and who are at risk of a changing climate. Cinner et al. (2015) base their assessment on nine indicators of adaptive capacity: human agency; access to credit; occupational mobility; occupational multiplicity; social capital; material style of life; gear diversity; community infrastructure; and trust (p.1); they find that adaptive capacity appears to have increased between 2008 and 2012 as a result of improved community infrastructure and access to credit. Salik et al. (2015), on the other hand, collect data to determine exposure, sensitivity and adaptive capacity at the household level, and find that 'lack of access to basic facilities, inadequate income diversification, and low education levels are negatively affecting the adaptive capacity of the entire local population. However, the communities' nature of dwelling, their strong family networks, and their ability to migrate contribute positively to their adaptive capacity' (p.61). Social cohesion and family/social networks were also seen as a strong contribution to adaptive capacity. Prado et al. (2015) examine past coping and adaptive strategies used to respond to social and ecological changes over time in a coastal community in Brazil; adaptation strategies included 'self-organization, collective action and political agency'; however, the authors recognise that over the years 'social cohesion has weakened due to increased economic rationality and conflicts – which may undermine social-ecological system resilience in the future' (p.29). Altieri et al. (2015) use a similar approach by considering the social networks and collective strategies used by farmers to help build the adaptive capacity and resilience of farmers to 'deploy agroecological mechanisms that allow [them] to resist and/or recover from climatic events' (p.886).

Adaptive governance is also a prominent theme amongst a number of the articles. For instance, Bell and Morrison (2015) look at adaptive and precautionary governance systems for land use planning against flood risk. They recognise that adaptive governance has emerged as the 'dominant response to the need to manage increasing complexity and change in social-ecological systems' (p.517). Bronen (2015) has a similar definition of adaptive governance, and uses this to consider community relocation as an adaptation strategy to the effects of climate change. Bronen (2015) states that in this context, 'implementing an adaptive governance relocation framework requires multi-level and diverse governmental and nongovernmental actors to engage in a collaborative process of knowledge production and problem solving (Kofinas, 2009)' (p.5). In Vedeld et al.'s study of urban multi-level governance of climate adaptation and flood risk management (2015) they explore the 'links between urban politics, multi-level governance, financial constraints and coproduction' that can enable or restrain adaptive capacity for resilient urbanisation (p.24). The authors find that despite being a medium-scale city, Saint Louis, Senegal, has demonstrated 'a set of smaller or incremental adaptation activities, some with transformative dimensions … This is in contrast to the capacity for adaptation revealed in the other four large African cities studied by CLUVA (Pauleit et al., 2015; Vedeld et al., 2015b)' (p.20). Furthermore, a number of articles have taken the concept of adaptive capacity even further to look at transformational change (Feola, 2015; Chelleri et al., 2015; Gilioli et al., 2015; and Eren and Günay, 2015). For instance, Chelleri et al. (2015) examine the adaptive and transformative capacities of urban areas exploring the 'nexus between urban sustainability and resilience in overcoming emerging vulnerabilities' (p.122). Gilioli et al. (2015) consider adaptation, transitions, transformation and resilience in their study that assesses social-ecological systems in peri-urban Ethiopian farming communities, looking specifically at new technologies and innovation within this process. These technologies are one important component of 'adaptiveness', and are key to improving sustainability of these socio-ecological systems.

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