SOCIAL DYNAMICS OF COMMUNITY RESILIENCE BUILDING IN THE FACE OF CLIMATE CHANGE

FAZEY, I[1*]; CARMEN, E[1]; ROSS, H[2], RAO-WILLIAMS, J.[3]; HODGSON, A.[4]; SEARLE, B.[3]; AL WAER[3], H.; KENTER, J.[1]; KNOX, K.[5]; BUTLER, J.R.A.[6]; MURRAY, K[7]; SMITH, F.M.[3]; STRINGER, L.[8]; THANKAPPAN, S.[1]

*Corresponding author: ioan.fazey@york.ac.uk

[1]Department of Environment and Geography, University of York, Heslington, York, YO10 5NG, UK

[2]School of Agriculture and Food Sciences, University of Queensland, Brisbane QLD 4072 Australia

[3]School of Social Sciences, University of Dundee, Perth Road, Dundee, DD14HN, UK

[4]H3Uni, 18 North Street, Glenrothes, Fife, UK

[5] Katharine Knox Consulting, York, UK

[6] CSIRO Land & Water, Brisbane, Queensland, Australia

[7]Kevin Murray Associates, Trinity House 33 Lynedoch Street Glasgow G3 6AA

[8] Sustainability Research Institute, School of Earth and Environment, University of Leeds, Leeds LS2 9JT, UK

Abstract

Demand is rapidly growing for practical knowledge about how to build community resilience to climate change. This research combined insights from social-ecological resilience and community development to implement and learn from an action-oriented, participatory, systemic, and relationship building approach in the UK. A grounded theory of underlying social dynamics involved was produced, leading to ten critical insights. The findings highlights that while resilience building is complex, there is significant potential for stimulating reinforcing processes towards more effective, collaborative and systemic kinds of action in line with the development of more regenerative kinds of cultures. The paper concludes that to advance 'how to' knowledge for resilience new framings of both research and resilience building will be required.

Keywords

Regenerative cultures; community development; action research; resilience building; capacity, vulnerability; systems; social dynamics

Introduction

Meeting global targets of maintaining temperatures at 1.5°C above pre-industrial levels while adapting to the growing impacts of climate change requires significant and rapid changes in technological and behavioural domains, energy systems and structures, governance, and in the worldviews, cultures, norms and beliefs underpinning high carbon societies(IPCC 2018). Within this context, there has been growing attention on building community resilience to shocks and stressors while also viewing it as a forward looking process to addresses deep underlying challenges associated

with climate change and inequalities (Pelling 2011, Pelling and Manuel-Navarrete 2011, Bassett and Fogelman 2013, Revi et al. 2014). Yet, while there has been extensive research on conceptual aspects of resilience (Chandler 2014, Cretney 2014, Choudhury and Haque 2016), there has been much less on understanding how to build community resilience in practice.

Communities are groups and individuals connected by common values, norms and/or interests, and sometimes a geographic place, that shape a shared sense of identity (Barrett 2015). Community resilience can thus be considered to be the ability to adapt to different kinds of social, environmental and economic change and in ways that promote further change towards healthy community functioning (Magis 2010, Wilson 2013). This can include enacting new systemic and cultural patterns (Wahl 2016); addressing fundamental issues underpinning inequalities, risks and vulnerabilities (Bassett and Fogelman 2013, Choudhury and Haque 2016); and developing resilience to both specified and unanticipated forms of change (Fazey et al. 2018a). Community resilience is relevant to many fields including community development, disaster risk reduction, fuel poverty, vulnerability, health, education and sustainability (Magis 2010, Wilson 2013, Aldrich and Meyer 2015, Berkes and Ross 2016, Mulligan et al. 2016, O'Donnell et al. 2018).

Recent reviews have identified essentials for community resilience (Fazey et al. 2018a) and highlight there are diverse approaches (Ross and Berkes 2014). These include capturing stories about place to inspire change, building intangible social assets to reduce vulnerability and promote resilience (Burnell 2013), and using community participation, assessment or planning (Pfefferbaum et al. 2015). Importantly, community resilience-building is predominantly a social change process involving different actors working and learning collaboratively (Hahn et al. 2006, Sitas et al. 2016, O'Donnell et al. 2018). It requires, for example, building relationships and trust, creating organizational linkages, boosting social supports, developing decision-making capacities and trusted sources of information (Norris et al. 2008, Cavaye and Ross 2019). Many initiatives are supported by local sponsors (e.g. local governments, NGOs) and all highlight the need for customised approaches for each unique community (Pfefferbaum et al. 2015).

Resilience-building is complementary to community development (Zautra et al. 2008, Ross and Berkes 2014, Henfrey and Giangrande 2017, Cavaye and Ross 2019). Community development provides important insights about how to achieve endogenous or sympathetically facilitated 'bottom-up' iterative processes and enhance confidence and capacities for collective working towards practical needs and to learn from successes and set-backs (Bhattacharyya 2004, Matarrita-Cascante and Brennan 2012). This includes insights about empowerment, improving well-being of the more disadvantaged within a society, and challenging structural relationships that keep such people disempowered (Brown 2016). Such work emphasizes the need for building capacities for self-reliance while also enhancing linkages and partnerships at higher social scales (Henfrey and Giangrande 2017). Social-ecological strands of resilience, on the other hand, highlight the need to work with systemic and interconnected issues, such as across sectors (e.g. adaptation and mitigation, water and food), social scales (e.g. from families, communities to governments), and time (past, present, future) (Berkes and Ross 2013, Wilson 2013, Chandler 2014, Wilson 2014). Such integrated working is essential for transcending the new challenges of the 21st century that cannot be addressed by more traditional silo based or piecemeal approaches and to help emergence of novel solutions. Community development and resilience both highlight the need for capacities for effective navigation of diverse norms, values, perspectives and interests (Voß et al. 2007, Brown 2016). Yet, despite important insights from both social-ecological strands of resilience and community development there has been limited cross fertilization of ideas between the two (Matarrita-Cascante and Brennan 2012, Berkes and Ross 2013).

This research aims to understand the social dynamics involved in resilience building to inform how it can be improved in practice. The work analyses the dynamics of the Scottish Borders Climate

Resilient Communities (SBCRC) project in the UK, which applied an action-oriented, participatory, systemic, and relationship building approach and combined insights from resilience and community development. The research is based on the assumption that to get to practical knowledge about resilience building requires learning from trying to do it in practice. The paper therefore does not aim to provide in-depth analysis of the project's outcomes but rather seeks to understand how resilience-building unfolded. The paper first explains the context and change process applied, followed by methods used to understand the social dynamics, the findings and discussion. The paper is important because it: focuses on the 'how' of community resilience building rather than the 'what' of concepts and problems; includes a novel process for resilience building; and presents a new grounded theory of the social dynamics involved.

Materials and Methods

The focal project

Aims and context

The SBCRC project, which brought together insights from resilience and community development, aimed to enhance resilience of three communities to shocks and stressors of climate change by working with interconnected issues and challenges. This involved operationalising ten essentials of resilience (Fazey et al. 2018a), such as working with interconnections across issues like housing, land use, inequalities, flooding, adaptation and mitigation; working vertically across governance scales; working with different normative goals, envisioning and enacting new futures and by encouraging learning and capacities for adaptability.

The fifteen month project (May 2015-September 2016) worked with three communities in the Scottish Borders, a region with a network of small market towns that historically developed along rivers to provide a source of energy to power a once thriving textile industry (McLean 2016). The region has an ageing demographic and is known for rural recreation (game fishing, mountain biking, tourism), large-scale farming and commercial forestry. Its most immediate climate related challenge is flooding, with eight areas being acutely disadvantaged in terms of flooding, including some of the larger towns and rural villages (Kazmierczak et al. 2015). Flooding is increasing (Werritty and Sugden 2013) and combining with other issues, such as potential rising food prices and low employment, to increase stress in communities. The sector most involved in working with climate change has been the emergency services and local government, such as through establishing local community resilience groups. This work has primarily focused on enhancing capacities to respond to shocks rather than being framed as working with climate change.

Communities were chosen because they had a history of growing impacts of climate change (mostly flooding) but also to provide different contexts and challenges (urban regeneration, commuter town, rural development) (Table 1). The project was implemented on a small budget (£100,000) with funds provided by the Joseph Rowntree Foundation's Climate Justice programme. The team included the University of Dundee, the Scottish Borders Council, Tweed Forum, Southern Uplands Partnership, the International Futures Forum and the Scottish Association of Marine Sciences. A dedicated project officer was embedded in the Scottish Borders Council. In total 284 individuals participated, with 219 attending workshops. Of these, 166 were community participants and 53 from established organisations, such as public bodies (e.g. Scottish Environmental Protection Agency, the Forestry Commission, and Scottish Borders Council); local organisations (e.g. Housing Associations and a large local Estate); and from other NGOs with a focus on rural development, energy and environmental management.

Four-tiered process for community resilience-building

A community resilience-building process was implemented that included eight main features, conceptualised as four interacting tiers (Figure 1, S1). The first tier focused on developing relationships and trust between the project team, community members and representatives from different organisations (e.g. statutory agencies, local government and non-governmental organisations). This was then supported by the second tier that focused on enhancing capacities to work with interconnections across issues, social scales and time and to enhance agency for more holistic approaches to resilience. The third tier then supported the first two by guiding how the project was implemented. This included: three workshops in each community and a policy synergy workshop; actions implemented in collaboration with different stakeholders in each community between the workshops; and implementation of principles of community development. These aspects helped ensure the process enhanced participation, co-learning and capacities for collaborative action. The fourth tier provided action-oriented research to iteratively support the project as it unfolded and to elicit insights for future initiatives (this paper). The 'research' was delivered in a participatory way to complement other tiers, including co-learning and relationship building. Full details of the resilience-building process are outlined in S1.

1.1 Research methods

Approach

The research aimed to develop 'how to' knowledge for resilience building. Such 'how to' knowledge has received limited attention compared to problem analysis in academia. Doing so requires different approaches that can elicit and develop practice-oriented knowledge, such as embodied techne and phronesis, as well as more abstract episteme (Rolfe 1998, Flyvberg 2001, Fazey et al. 2018b). To advance 'how to' knowledge, this study was therefore framed as second order research (Umpleby 2016). This rejects the often implicitly held assumption that researchers can and should be independent of what they observe. Instead, researchers actively work 'as if from within' the system being studied (Umpleby 2016, Fazey et al. 2018b) with knowledge generation and action viewed as being closely intertwined and being more aligned to issues of community importance (Greenwood and Levin 2007, Umpleby 2016).

This framing enabled a co-creative process where different actors played diverse and complementary roles. For example, 'researchers' acted as facilitators, project managers, and knowledge brokers and 'practitioners' acted as researchers, such as by helping collect and make sense of data and by being critical observers. It included a primary 'pracademic' (E. Carmen) who was both the central actor and meaning-maker. Validity was then assumed to have been enhanced because participant researchers were closely aligned to the messy real-world of action enabling them to learn from it rather than being divorced from its practice. This was, however, also supported by systematic processes that encouraged reflexive monitoring about how being embedded influenced insights as they emerged and which aimed to keep ambitions of the project high (Arkesteijn et al. 2015) (Appendix 1).

Data collection and analysis

While researchers were embedded in action, to understand the social dynamics of resilience building, four explicit data sources were collected:

1) A reflexive diary kept by the primary pracademic: This provided detailed reflections on discussions, workshops, meetings, local policies, practices and initiatives, how the project was unfolding and why, emerging storylines and narratives, and critical learning and observations about the social dynamics involved. Diary entries were made throughout the project, such as after

significant meetings and workshops or when faced with obstacles or challenges.

2) Formal interviews conducted by an evaluator (XXXXX): This included 47 face-to-face or telephone interviews of 20-30 minutes, mostly with the same participants at different project stages (27 different participants, with 9 from the project team, 9 from participating organisations: and 3 from each community). Interviews focussed on project progress, what was or was not being achieved, challenges and opportunities, and assessed tangible, capacity building and learning outcomes. Findings were fed into the project as well as being used in later analysis.
3) Surveys to evaluate the ten workshops to understand participants' perceptions of project progress and their learning.
4) Three formal reflective meetings and a final reflective workshop with the project team: This helped surface new insights, confirm or challenge emergent thinking, and consider why particular outcomes and findings were occurring.

Data were triangulated and analysed to develop a grounded theory of the social dynamics of resilience-building through three iterations (Figure 2a). This included: coding and development of project timelines and the different influences on emerging outcomes (Figure 2b); refining timelines with team members; further refinement and development of a causal loop diagram (CLD) (Sterman 2000) to show key influences and feedbacks and enable wider systemic insights to be derived (full details in S1).

Table 1: The three communities involved in the resilience building project

Town	Character and issues
Peebles	• Originally an important market town with a population of around 8,000. • River Tweed and its tributaries run through the town. Some areas of the town located close to these watercourses have a history of flooding; • Close proximity to Edinburgh with good transport infrastructure. Many residents travel to Edinburgh for work. Educational qualifications are generally high; • A high number of elderly people with many young adults moving away to access a wider range of work opportunities. • Numerous community groups, such as those focusing on local food, youth development. A Community Resilience Group works to address flooding in the Tweed Green area. • A key challenge was managing issues with Peebles being a commuter town (e.g. many people being absent during the day reducing cohesion, high house prices making it difficult local people to remain).
Hawick	• Industrial town centrally located and one of the largest in the region with a population of around 15,000; • The town grew around an internationally renowned textile industry with mills powered by the waterways that run through the town. • Industrial decline has led to job losses and a reduced population, especially younger, more economically active people. • Many industrial buildings remain and there is a history of flooding across large parts of the town. • There is an active, self-initiated local flood action group and a recent Community Resilience Group established by the Community Council and the Scottish Borders Council. • The primary challenge facing Hawick is how to enhance urban regeneration of the town.
Newcastleton	• The remote, rural community is in the far south west of the Scottish Borders region with around 800 people; • Newcastleton was a planned settlement, built on the flood plain by a local landowner in 1793; • Main sources of employment are forestry, agriculture, and tourism, with main conurbations being 22 miles away on roads that are often single lane. • Over the last few decades, the village has lost a number of key services (e.g. petrol station, railway) • There is a relatively high number of elderly people in the community and young people often move away for employment. • The community council and the community development trust are key groups, with much of the focus on strengthening physical connectivity e.g. IT and transport. • The community is well organized, and despite not having a formalised resilience group, it provides support in emergency situations. • The village is exposed to flooding on a regular basis; • The primary issue facing Newcastleton are the challenges of rural development.

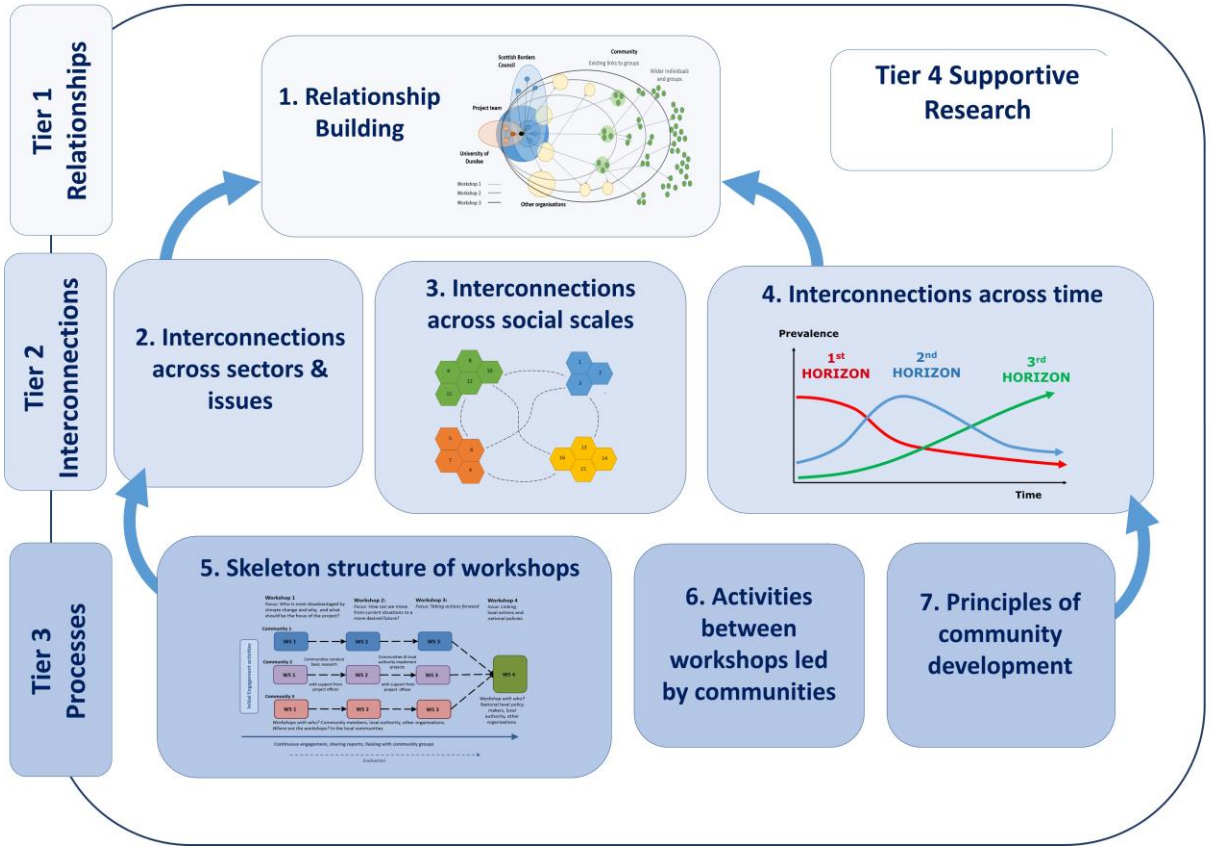

Figure 1: The four-tiered community resilience building process (See also S1).

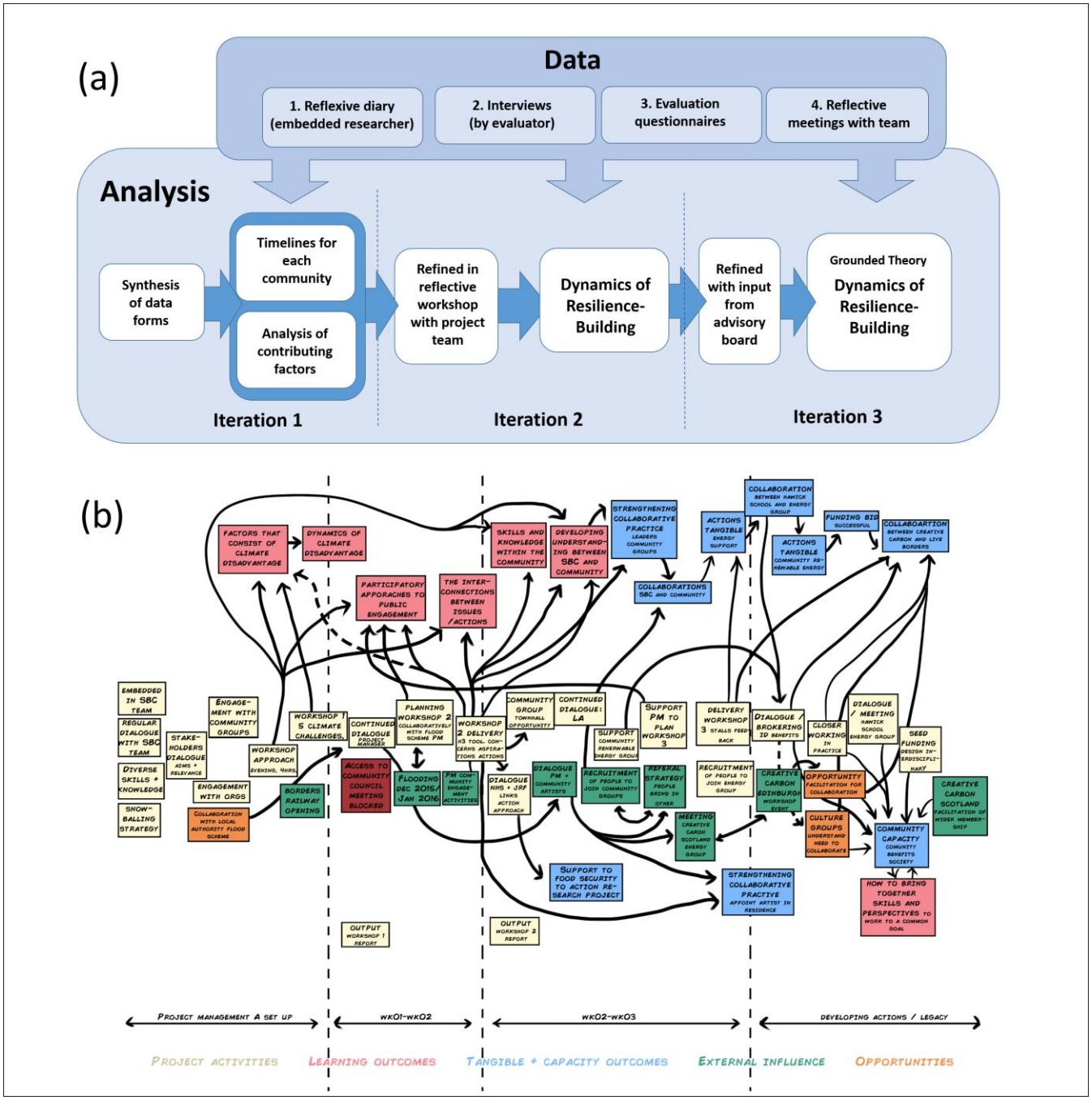

Figure 2: Analysis: (a) The iterative process of data anmalysis and refinement of the emerging grounded theory towards the end of the project; and (b) an example of a timeline produced for each community in the first iteration and refined in the second iteration.

Results

The resilience-building unfolded in different ways in each community (Table 2, Figure 3). In Hawick, the project capitalised on existing work of the local government and engineers who were designing a new flood scheme to bring in community members to re-shape designs so the scheme contributed to wider systemic issues. In Peebles, effort focused on building relationships between diverse actors, which eventually led to establishing a community based resilience group to work collaboratively with local emergency services. Finally, in Newcastleton, new relationships between the community and local authority were formed, leading to new collaborative working groups and community based initiatives (Table 2, Figure 3).

From a critical stance the tangible outcomes may seem limited. Yet, while we do not seek to over-claim success, in a short period the project also laid important foundations and capacity for collective working across different sectors and governance scales from which longer-term systemic interventions were beginning to become possible. Had the project received longer-term support, more transformative and holistic outcomes and action are therefore likely to have emerged. The grounded theory emerging from the analysis explains how the different aspects of the social dynamics led to these important foundations (Figure 4). These dynamics included five main reinforcing loops (R1-R5) and four key influencing factors.

Reinforcing loop 1: Strengthening relationships enhanced collaborative action

The first reinforcing loop, relationships and collaborative action (R1, Figure 4) represents how enhanced *strength of relationships and trust* from relationship-building efforts (e.g. enhancing connections between actors, convening dialogue, mediation between groups) led to greater *willingness and ability to wield power collaboratively*. Social power had been expressed in the project in different ways, such as how participants shared or withheld information; enabled or allowed meetings; chose to be absent or present; held on to, or chose to apply scarce human, monetary or physical resources; or in the way they made different decisions with or without certain people. Power was thus not simply wielded by those in local government because they could make decisions across wider geographical scales and provide equitable support over a large number of communities with limited resources. This made the local government highly dependent on cooperation by community members who, while needing support, also wielded their own kinds of convening power such as in making choices about the events they engaged. As greater willingness to collectively wield power emerged, however, this then increased *likelihood of effective collaborative, systemic action*.

An example was in Newcastleton, where community members already had extensive motivation and considerable capacity for action, but were initially deeply concerned about loss of autonomy if they engaged worked more closely with the local authority in which the community had limited trust. Extensive effort was then made in the project to enhance working relationships, with the project officer and those from a third party organisation often acting as mediators. Once initial levels of trust had been developed, multiple actions rapidly flowed (Table 2, Figure 3). Thus, as collaborative working increased, then so did the development of stronger or more effective relationships and trust, closing the feedback loop (Figure 4, R1). In all cases collaborative working continued for at least two years after the project ended. In Newcastleton dialogue continued through partnerships to examine land-use (Table 2) and in Hawick a community group established in the project had made significant progress in developing a renewable energy scheme. Enhanced collaborative action between communities and local government also directly enhanced effectiveness of responses to flooding and extreme weather events of winters 2016/17 and 2017/18. Thus, the extensive focus on relationship and trust building proved critical for longer-term, novel and collaborative outcomes.

Reinforcing loop 2: Learning about systemic aspects enhanced likelihood of collaborative systemic action

The interviews with participants highlighted the process stimulated greater learning about what constitutes disadvantage, the systemic nature of climate change, processes and skills in facilitation and community engagement, and the diverse expertise of others (e.g. about flood risk, renewable energy, community development, poverty initiatives) (Fazey et al. 2017). This learning enhanced the way participants understood interconnectivities between issues, with this enhanced *holistic understanding* increasing *likelihood of collaborative and systemic action* (R2, Figure 4). In Hawick, for example, as the floodscheme began to be viewed more widely and in holistic ways, other working groups emerged that focused on the arts, education, economic development, and recreation, enhancing possibilities for systemic action. Further, while not fully evidenced, there were also suggestions that engaging in more systemic-oriented aspects reinforced holistic understanding (R2, Figure 4). Future initiatives seeking to enhance ability to work with interconnections between issues therefore need to increase the opportunities for doing so.

Reinforcing loop 3: Learning to understand the understanding of others enhanced relationships and collaborative action

The extensive work on engagement exposed participants to diverse perspectives, mindsets, values and expectations of others. Many of those involved expressed how this helped them develop *understanding of the understanding of others* which in turn increased *strength of relationships and trust*, leading to more *collaborative action*, closing the feedback loop (R3, Figure 4). In the project, the loop was enhanced by actively surfacing and working with different mindsets, assumptions and action logics. For example, there were different perceptions of how change was expected to come about and who had power in decision-making. In many cases, the different perspectives stemmed from adherence to traditional notions of governance and control. For example, those from local government often implicitly assumed a more top-down approach because they could not see how devolving decision-making would enable them to retain sufficient control to ensure statutory obligations, such ensure safety of the public against floods, were met. While many such issues were difficult to surface and challenge, when it did occur, substantial breakthroughs occurred. For example, in Newcastleton mediation between opposing perspectives unleashed possibilities for a new kind of relationship, unlocking possibilities for a number of different initiatives to emerge. (Figure 4, R3). Overall, ability to surface enhanced understanding of the understanding of others and work with this in constructive ways proved important for systemic and collaborative outcomes to occur.

Table 2: How projects unfolded in each community.

Town	Storylines and outcomes
Hawick	Storyline • Collaboration quickly established in early phases between the project team and the team developing the Hawick flood scheme. • First workshop explored climate change disadvantage and further consolidated collaborative working; • Series of flood events hit the town (1 in 55 year event), occurring 5 days before, and enhancing interest in the second workshop; • Second workshop used diverse participatory methods to explore local impacts from the recent flooding, followed by visioning and then considering how an alternative future for Hawick could be developed using community action to generate multiple solutions through changing the design of the Hawick flood scheme; • An extensive programme of community action including different work streams led by community members (e.g. renewable energy, art, education, business, regeneration) developed ideas; • Ideas fed into a large community exhibition (third workshop) about how the proposed flood scheme could create potential synergistic ideas for wider community benefits, such as implementing community water powered renewable energy; • Continued support was provided to develop the community renewable energy actions, including work to strengthen links with other work stream groups Outcomes • New studies and funding to continue community engagement and progress specific actions, e.g. external funding for an in river renewable energy feasibility study; • New partnerships to continue to progress actions grouped around specific issues, such as cultural identity, renewable energy and supporting the local economy; • Increased capacity for collective action to build community resilience to climate change through joining work on climate adaptation, climate mitigation.
Peebles	Storyline • Bringing together wide range of community oriented groups; • Examining climate disadvantage, with community research team to explore this further, including from local housing associations; • Using Three Horizons to explore alternative futures and actions. The latter included focus on adapting to flooding, youth employment and climate change mitigation; • Series of flood events (1 in 50 year events), resulting in change in focus towards expanding a community resilience group to include the whole of the town; • Third workshop builds on the new momentum following floods to explore how to fully establish and sustain the community resilience group. Outcomes • Learning outcomes, such as about systemic issues, community participation tools, and disadvantage were high; • New, more collaborative relationships between the Scottish Borders Council and community members were formed and enhanced; • The community-based resilience group continues to be active, with major contributions to other crises and challenges affecting the town.
Newcastleton	Storyline • Climate disadvantage was explored in first workshop; • High river flows resulted in precautionary evacuation of households; • Second workshop explored alternative futures for the community and identified actions to help bring this about; • Activities between the workshops focused on building relationships and understanding between the project team and key community members, for example those involved in the community council and the community development trust; • The third workshop was co-designed with key community members. It examined four issues for collaborative working: local flood risk management; establishing a community resilience group; improving energy efficiency; and mobile phone and broadband coverage. The workshop included discussion with different local and national level government and non-government organisations (e.g. Forestry Commission, Broadband Scotland, Home Energy Scotland and Rural Housing Scotland). Outcomes • Action plan co-developed between the Scottish Borders Council Emergency planning team and key community members for a collaborative community resilience group; • Inclusion of the community in an initiative examining broadband coverage in the wider area being led by one of the project partners (Southern Uplands Partnership); • Capacity for collective action between the community and local organisations.

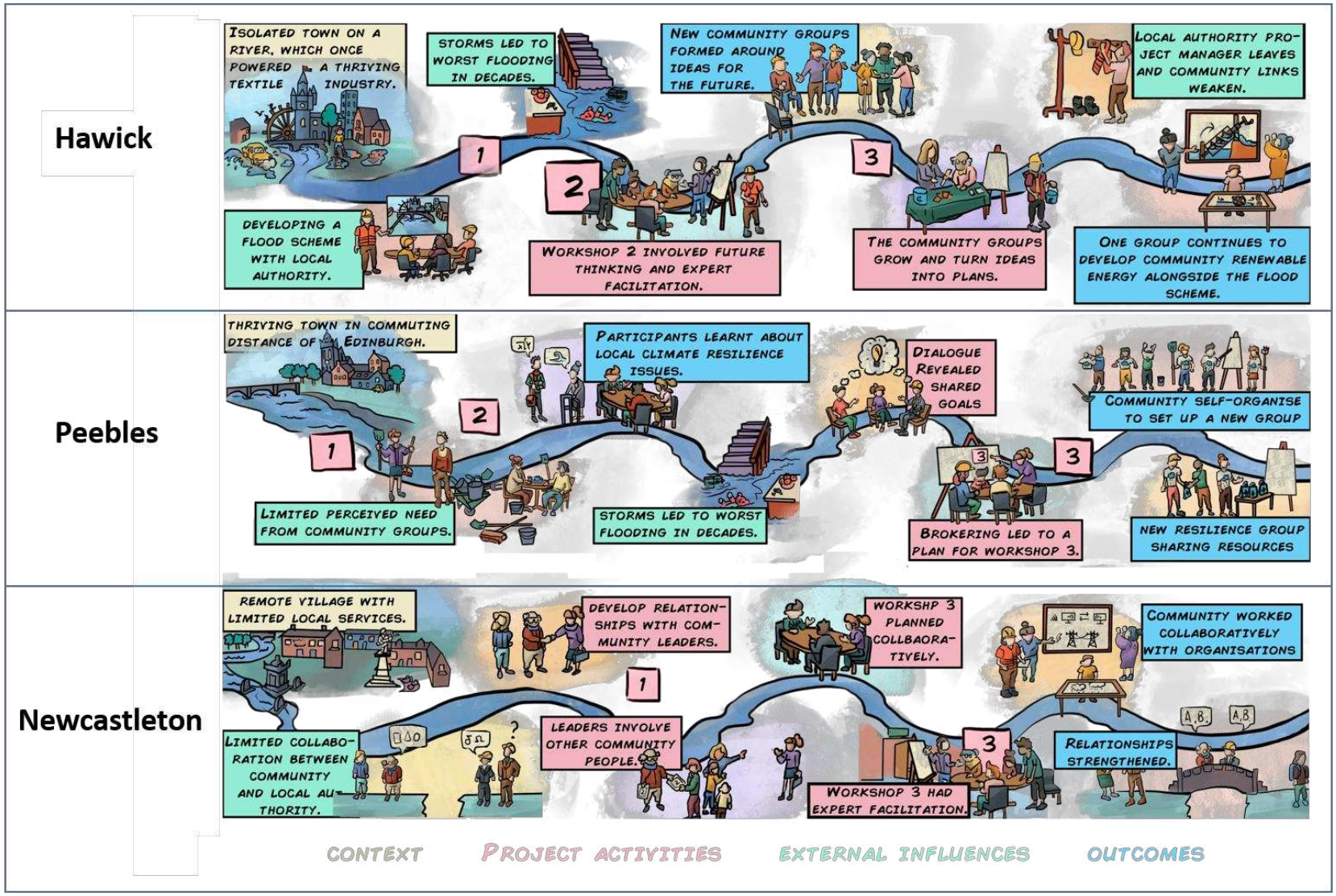

Figure 3: Visual overview of how projects unfolded in each community. Yellow boxes are the issues around context of each community; pink boxes the project activities; green boxes external influences and blue boxes key outcomes. Numbers refer to the workshops, which provided structure around which other activities occurred.

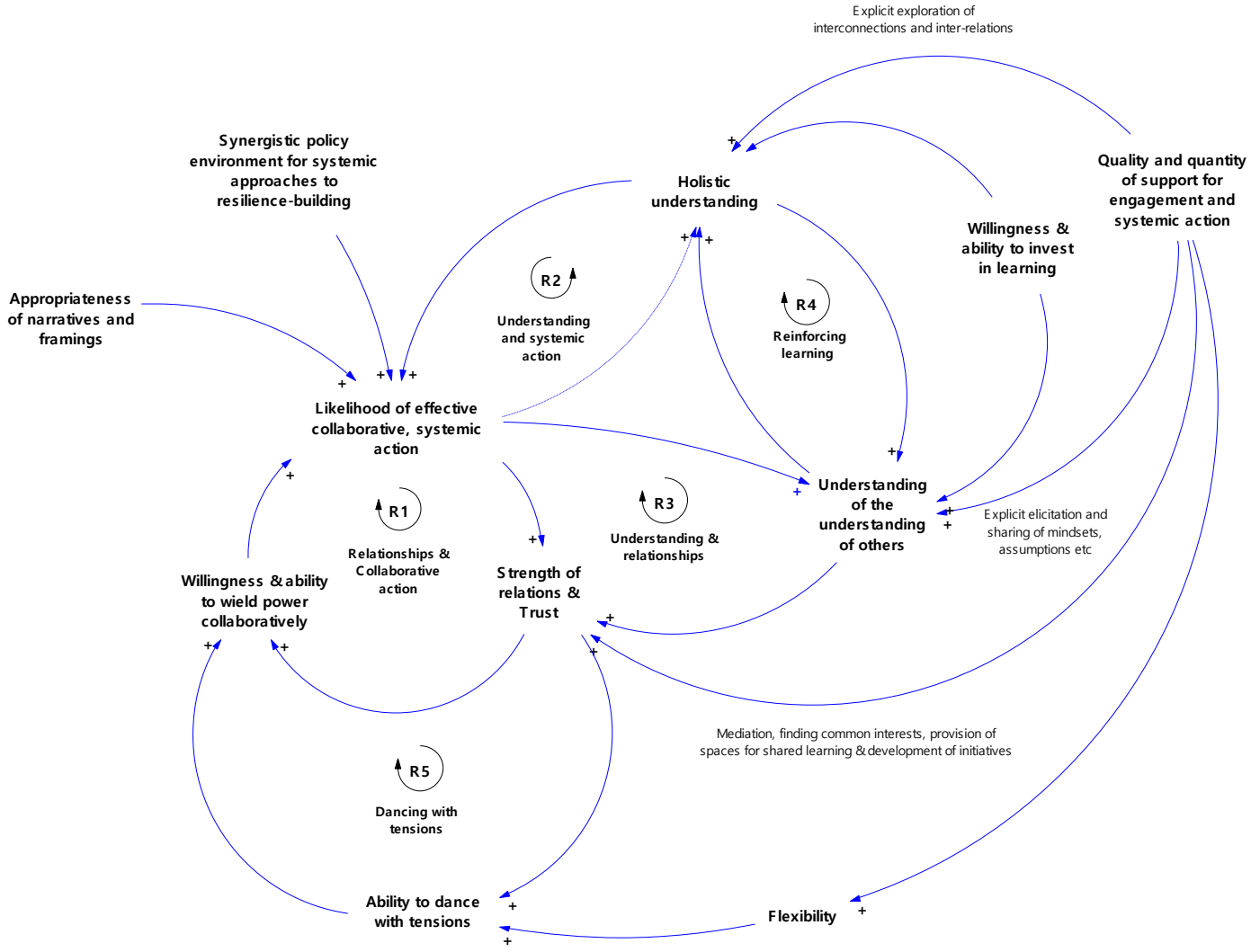

Figure 4: A grounded theory of the social dynamics of resilience-building represented as a causal loop diagram (Sterman 2000). Arrows indicate a causal relationship between variables with the direction of the arrow indicating the influence of one variable on another. Polarities explain the nature of that relationship. Positive polarities indicate that when an initial variable increases or decreases, the variable it influences changes in the same direction. 'R' labels indicate reinforcing feedback loops. That is, the direction of change (increase or decrease) in one variable affects other variables so as to reinforce the direction of change in the initial variable. Solid lines are influences supported by empirical research findings and dashed arrows appear to be occurring, but have not been fully substantiated.

Reinforcing loop 4: Learning to understand the understanding of others enhanced understanding of interconnections between issues

Enhancing *understanding of the understanding of others* also enhanced *holistic understanding* and appreciation of the interconnected nature of climate resilience (R4, figure 4). For example, in Hawick participants' different orientations to the future were explored in a workshop to shape the design of a new floodscheme. The workshop, by chance, occurred five days after a major flood that had created significant damage in the town. Tensions in the workshop were extremely high but the futures approach did help participants work simultaneously with different future-oriented mindsets (managerial, entrepreneurial and visionary). Surfacing and legitimising all three mindsets completely changed the atmosphere from one of anger and fear to one of hope, motivation and greater trust, and ultimately to formation of highly motivated working groups. This opened up space for greater appreciation of the holistic nature of the challenge, increasing *understanding of the understanding of others*, thereby closing the feedback loop (Figure 4, R4). The key lesson here was that enhancing understanding of the understanding of others through surfacing and working constructively with different mindsets enhanced willingness and capacity to work with interconnected issues.

Reinforcing loop 5: Dancing with tensions

Enhanced *strength of relationships and trust* also enhanced *ability to work with tensions*, which led to greater *likelihood of collaborative action*, reinforcing *relationships and trust* (R5, Figure 4). Tensions are dilemmas that cannot easily be reconciled and for which there is no single way to approach them (Höijer et al. 2006). Instead, continuous reflection and re-orientation is needed to 'dance' within an accepted bandwidth between the extremes of the different dimensions involved (Sharpe et al. 2016).

In this project, many different tensions were experienced (Table 3). This included tensions between perceived need for achieving quick outcomes versus long-term goals and between the extent to which participation versus direction was needed, with some community members wanting more involvement in decisions and action while local government members struggled to see how this could be achieved. In some cases tensions were able to be managed through balancing other tensions. For example, participation versus direction was partially foreseen and managed by balancing structure versus flexibility, where a skeleton of community workshops provided a degree of direction (Figure 1) but which was then used flexibly depending on shifting and emerging needs stemming from participants. Achieving balance between participation and direction was further supported by balancing provision of support versus encouraging autonomy, where there was a continuous dance between assisting community activities and then stepping back to encourage ownership and autonomy. This, however, was complicated by independence versus vested interests of project team members, where the project team needed to be independent to provide genuine facilitation and participation but who also were accountable to their own institutions and project funders.

Overall, as relationships and trust were enhanced, those involved developed greater willingness to work with tensions in more constructive ways, leading to greater likelihood of collaborative and effective systemic action, and eventually closing the feedback loop (R5, Figure 4). This was enhanced by anticipating tensions, which suggests that future projects could be enhanced by surfacing tensions at the outset and finding ways to work flexibly with them.

Table 3. Tensions experienced in community resilience building.

Tension	Explanation
1. Climate change focus vs Local interest	Focusing directly on addressing climate change issues may not be directly aligned with immediate interests or perceived needs. There is a key challenge about how to maintain interest while also moving towards a genuine focus on climate change.
2. Holism vs Focus	Integrating issues and connecting agendas is important to enhance community resilience, but too broad an approach can limit focus and direction.
3. Generalised vs Specified resilience	Enhancing generalised resilience is important for developing capacities to respond to unanticipated shocks and stressors while specified resilience is needed for specific issues (e.g. floods or droughts). While both are important, they require different approaches and emphasis. Decisions are needed about where to allocate effort and resources.
4. Learning vs Tangible action	Encouraging learning about complexities and inter-related issues is important but with limited time and resources this can detract from achieving more tangible outcomes ('getting things done').
5. Relationships vs Tangible action	Building relationships and trust is critical for collaborative and longer-term outcomes but takes time and extensive effort. In some cases, too much focus on this aspect may detract from achieving more immediate outcomes.
6. Quick wins vs Longer term outcomes	Achieving immediate outcomes is important to maintain interest, but this can be at the expense of achieving a sustained legacy from a project. Most resilience builders will be under extensive pressure to deliver day to day activities and may have limited resources to focus on integration across sectors and time, which will be important in the long-term.
7. Depth vs Breadth	Considerable attention to working with a small number of communities may not be sustainable larger scale impacts. Thus while relationship-building and in-depth learning is important, it may be difficult to know how to take work forward once a project has been completed.
8. Innovations to support status quo vs Innovations for change	Innovations are likely to be needed to address immediate concerns, but these also tend to support existing ways of doing things. Innovations are also needed that disrupt the status quo and lead to more transformational kinds of change. This tension often manifests as different perceptions of stakeholders and team members about what is most important or urgent, and can stem from different demands placed upon them.
9. Participation vs direction	Genuine participation and engagement takes time to form new, or strengthen existing, relationships and requires perceptual changes in the relative roles of the individuals or groups involved. Yet being highly participatory can sometimes detract from achieving goals, which can sometimes be better achieved through greater control and direction.
10. Structure vs flexibility	Sufficient structure is needed to ensure a degree of focus of a project and maintain motivation for participant engagement. However, a high degree of flexibility is also needed to meet different stakeholder needs and to work with challenges and opportunities as they arise.
11. Providing support vs encouraging autonomy	In many communities, support is needed to manage and work with the complexities associated with climate change. However, provision of too much support can create dependency. Thus there is a tension between how much support should be provided and how to encourage greater autonomy. Facilitators need to balance stepping back and handing over ownership with the possibility of an action failing, while also being able to step forward to provide support when capacity may be lacking.
12. Independence vs Vested interests	Independence is needed for effective facilitation, but this is not always easy to achieve given that it is rare fully independent facilitators will be available. Project team members are likely to have vested interests such as needing to deliver what is needed from their respective organisations.
13. Participation as empowerment vs Participation as a means to an end	Tensions are likely between having projects that aim to be genuinely empowering, with participation viewed as an end in itself and ideas generated being community owned and developed, or whether the projects and participation are mostly viewed as a means to an end, with the 'ends' being pre-determined and participation used to help achieve those ends. The former places a strong emphasis on capacity, learning, and relationship building and the latter is more focused on achieving more immediate or tangible outcomes.
14. Embedded vs Independent researchers	Research is critical for informing projects as they progress. While having researchers embedded within projects and involved in action can enhance learning about the process because they are closer to action and develop know how knowledge there are also sometimes advantages in having a more independent perspective.
15. Data collection vs Action	Resilience-building is primarily an action, but which can be supported by research. Tensions may then arise around the extent to which engagement with diverse participants is designed for dialogue or whether it is designed for the elicitation of data which, when analysed, can enhance learning about how to improve the process.

Influence 1: Willingness or ability to engage in radical learning affected potential for transformational outcomes.

In addition to reinforcing loops, there were four critical influences affecting how projects unfolded (Figure 4). The first was *willingness and ability of participants to invest in learning*, which was key to exploring and breaking out of particular mindsets and assumptions (Figure 4). Many participants,

for example, missed critical opportunities for learning because, at short notice, they were required to respond to urgent duties elsewhere. New approaches that can quickly draw out implicit thinking, work with underlying assumptions, and enhance willingness of those involved to engage with uncomfortable and messy learning processes are therefore needed. Finding ways to do this was a significant challenge in the SBCRC project.

Influence 2: Quality and quantity of support affected opportunities for relationship building, learning and working flexibly with complexity and tensions

Quality and quantity of support was critical to achieving collaborative and systemic action (Figure 4). This support included high level skills in facilitation, participation, and working with systems and futures. While such skills are often highlighted as important (Hagmann et al. 2002, Sitas et al. 2016), they are also often overlooked, not sufficiently resourced, or available. In the SBCRC project the dedicated project officer was essential to support community based projects while facilitation and futures methods and skills were key for working with tensions, encouraging holistic understanding, understanding others, and in strengthening relationships and trust (Figure 4). Quality support also enabled flexible working. An example was when major floods struck each community, providing opportunities to galvanise action and form new resilience groups in Peebles and Newcastleton. Flexibility was also greatly enhanced by having an adaptable funder and a project focused on 'softer' process related goals of learning and relationships as well as more tangible fixed outcomes. Overall, the quality and quantity of skilled support proved to be a necessity rather than a luxury.

Influence 3: Framings of resilience shaped community resilience building

The *appropriateness of narratives and framings of resilience* affected *likelihood of collaborative working and potential for systemic action* (Figure 4). For example, in Newcastleton, resilience was framed by the community as coming from building capacities to work with longer term stressors such as employment and limited access to infrastructure. This was in contrast to those from the local government who framed resilience as enhancing efficiencies and ability to respond to shocks. Lack of alignment of framings slowed collaborative working and detracted from working towards longer term challenges, such as those associated with climate change.

Influence 4: The policy landscape influenced community resilience initiatives

A key influence on community resilience building was the *policy environment*, including wider political, legal and decision-making contexts in which communities and local governments were embedded (Figure 4). Four key aspects were identified by policy professionals that limited effectiveness of community resilience building: (1) tendencies to favour economic growth over longer term climate resilience in cost-benefit decisions; (2) limited community capacity to work with climate challenges; (3) poor coordination across policy domains that limited opportunities for multiple gains; and (4) limited approaches for working with highly interconnected challenges.

Overall dynamics

The combined 'system' of the social dynamics of resilience building (Figure 4) has important implications. First, the different components were all critical to overall system dynamics, providing ten lessons to guide future initiatives (Table 4). Importantly, however, when these aspects enacted together, they have potential to stimulate a beneficial reinforcing process. That is, once critical thresholds in relationship building and trust begin to be achieved, and with support from working with other elements in the system, resilience building can begin to reinforce itself. This suggests that, at least theoretically, major change may be possible in the long term if there is an appropriate focus

on systemic forms of change, the capacity to work with it, and sufficient attention to capitalise on the reinforcing nature of the social dynamics involved. Thus, while wider socio-political scales are important and achieving deeper transformational change is difficult, communities in this project did begin to appear to be developing agency and capacity for change when they had appropriate kinds support to help them be the drivers of the change they sought to achieve. This did, however, require extensive work and support to get things moving, and it was not clear how much and for how long support would be needed for such shifts in capacities to become more deeply embedded.

Discussion and Conclusions

This research sought to help meet growing demand for knowledge about how to do community resilience-building in practice by learning through action. The findings highlight the complexities of resilience-building, requiring those involved to work with the messy and often intangible world of mindsets, assumptions, desires, relationships, power and trust. This, in turn, requires a complex array of resources and capacities and being ready to capitalise on different opportunities as they emerge (Table 5). Much of the challenges encountered related to inability of those operating at a single community scale to influence wider social contexts, including socio-political conditions, governance, fiscal and legal structures, framings and narratives. There were also significant challenges in going beyond focusing on more immediate and visible issues like emergencies, towards addressing deeper underlying systemic challenges. A need for a new kind of research agenda is thus needed that can develop and test new approaches for working with interconnected challenges in practice.

There is relatively little we would change given the resources available and context of the project. However, in future projects we would place a much stronger emphasis on finding new ways to work with underlying assumptions, particularly among the project team. This could, for example, be enhanced by using the tensions identified (Table 3) to focus dialogue about underlying assumptions about how change was expected to come about. Importantly, however, the results do highlight promising potential to capitalise on the reinforcing nature of the social dynamics involved (Figure 4). A goal for future resilience-building would thus be to work with the ten key lessons (Table 4) to build self-reinforcing systems similar to emerging attempts to build regenerative systems in other domains (Wahl 2016). This, in turn, requires reframing community resilience building from being primarily about harm reduction to viewing it as a process of creating dynamics that reinforce restoration of critical community functioning, health and viability. This is not a goal that should be taken at face value as it would require significant effort to help create the pattern shifts needed for the realisation of such outcomes.

The project also has important lessons for research. Having researchers embedded in the action provided greater opportunities to develop ‘how to’ knowledge for resilience. This only worked, however, because it was accompanied by systematic mechanisms that forced critical reflection on how embeddedness influenced meaning-making and provision of opportunities for stepping out of action when a more critical stance was required (Arkesteijn et al. 2015). Further, the focus on the building of a conceptual model of the social dynamics of the resilience building process was important rather than focusing on the dynamics of the problem (e.g. of existing relationships or dynamics between actors). This represented a subtle but important shift enabling the work to go beyond critiquing problems or solutions to actively supporting the development of insights about resilience building as a practice.

Importantly, development of this ‘how to’ knowledge was ultimately made possible by approaching the research as if from within the system being studied. This enabled the research to move away from viewing the production of knowledge as the primary goal to viewing the goal as primarily being action, but with research to support that action. Contemporary knowledge production systems have

been heavily criticised in a context of major global challenges like climate change because of their focus on knowledge production rather than societal improvement or the production of wisdom about how to act (Maxwell 2007, Kläy et al. 2015). Thus, for research to develop relevant 'how to' knowledge, in addition to new framings of resilience building, new framings and practices of research will also need to be creatively developed and scaled.

Table 4. Ten requirements for emergence of a self-reinforcing process of community resilience building

Lesson
1. Work towards enhancing relationships and trust in ways that lead to collaborative action, and with collaborative action to support and reinforce relationships and trust;
2. Build understanding of, and support for working with, the different kinds of power held by different actors that can work in synergy to achieve collaborative and systemic outcomes;
3. Focus on enhancing learning about interconnections and inter-relations between challenges and how solutions contribute to, or reinforce systemic outcomes;
4. Focus on surfacing and making explicit, and find ways to work with, different values, mindsets and assumptions;
5. Invest time, effort and enhance willingness to engage in deep and systemic learning;
6. Provide appropriate quality and quantities of support for engagement, participation and systemic action;
7. Build in, and ensure support for, high levels of flexibility during resilience-building actions;
8. Make tensions explicit, and work with these in flexible ways;
9. Make wider narratives and framings of resilience, governance and change explicit, and explore how these affect the approach undertaken to enhancing community resilience;
10. Develop a deep understanding of how current policy environments support or hinder community-resilience building and use this to strategically develop alliances, navigate governance at wider scales, and make strategic locally based decisions.

Table 5. Lessons from the SBCRC project about the practical aspects needed for resilience-building in the context of climate change

Design and implementation	
Design and implement for participation and engagement	Ensure objectives are flexible to increase the perceived added value for partner organisations
Focus on identifying strategic relationship-building and partnership needs	Link activities across different issues and with local interests, initiatives and expertise
Play a mediator role in developing trust and relationships	Identify and work with change oriented leaders
Have a direct focus on climate change and enhance climate literacy	Be clear about what is possible
Pay close attention to different expectations of team members	Work with and enhance existing resources and capacities
Take a holistic and systemic approach to embrace complexity and interconnectivity	Provide spaces for dialogue that reduce hierarchies and encourage participation
Focus on climate disadvantage, with appropriate methods for inclusion	Be flexible in workshop design and facilitation to respond to local needs
Orient conversations that situate the present in relation to the future	Work with and link climate change to local issues
Partner with local organisations	Ensure time is available to explore complexities
Ensure project officers are locally embedded and immersed within the social setting	Find simple language to convey complex issues
Strive for credibility (high quality) and relevance (usefulness)	Provide support to develop new collaborations and relationships between stakeholders
Ensure senior support in partner organisations	Ensure the process is flexible to enable diverse outcomes to emerge
Ensure time for developing shared understanding and desired outcomes in core team	Design for learning and knowledge exchange to maximise potential for future capacities
Use existing engagement routes to strengthen multi-stakeholder collaboration	Make learning explicit so that changes emerging in project are more visible
Focus on relationship building with stakeholders	Iteratively feedback learning to adaptively shape a project
Ensure clarity of project team roles	Build in legacy planning to enable continuation beyond projects
Pay attention to different forms of power in relationships, and how these are strategically used by partners to retain control, ensure different interests are achieved, and needs are met	Engage communities in early stages of project design rather than assuming they will participate
Skills, expertise and capacities for project teams	**Creating and capitalising on opportunities**
Knowledge brokering,	Turn crises into opportunities
Diversity of participation and facilitation expertise	Develop basic plans to capitalise on both known and unanticipated opportunities
Systemic capacities that enable working with inter-related issues	Work with local interests of community members
Local expertise about context, relationships and networks	Work with existing community drive
Diverse expertise in core team (e.g. systems and specific technical expertise)	Collaborate with other projects/ initiatives within communities
Ability to bring in additional specific expertise where necessary	Feed up local issues, actions and outcomes into regional or national scale policy
Strategic oversight to balance flexibility with focus	Be legacy oriented, viewing projects as part of a longer journey within a wider social setting
Capacities for relationship building and collaborative working	

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Supplementary Material (S1): Four tiered process used for community resilience building

The community resilience-building process in the action-oriented research project was designed and implemented as part of the Scottish Borders Climate Resilient Communities Project in the UK between May 206 and September 2017. The SBCRC project aimed to enhance the resilience of three communities to shocks and stressors of climate change by operationalising ten aspects of resilience-building (Table 1). This supplementary material outlines the eight main features conceptualised as four interacting tiers, with each tier below supporting each of the tiers above (Figure 1). Each of these tiers is outlined below.

Tier 1: Relationship and trust building

The first tier recognised that resilience building is predominantly a social process. As such, a primary focus of the project sought to build relationships and trust, which was considered essential for helping enable collaborative action. While relationships and trust are often advocated as important (Hahn et al. 2006), how such aspects should and can be developed in resilience building are rarely made explicit. This project therefore involved explicitly bringing into the process different activities, such as convening dialogue, creating safe spaces for exploring ideas, brokering, mediating, iteratively providing support then standing back to encourage autonomy, encouraging and making connections, having the project officer working independently from the local government to emphasize a degree of independence and ability to be perceived as an 'honest broker', and working with different actors to find common ground. The active process of helping to build relationships was also supported by an explicit engagement strategy that brought participants together. This involved: (a) using a 'hook' of flooding to provide focus for wider conversations and activities for community resilience to climate change; (b) working with existing engagement routes of the Scottish Borders Council, such as with flood resilience groups, to access diverse actors (Figure 2); and (c) ensuring the process was transparent and open, such as through continuously sharing emerging information (e.g. by providing workshop reports).

In the Scottish Borders formal relationships between the local council and community councils generally provide the primary mechanism for community consultation and engagement. Similarly, other departments within the council have also established less formal relationships with specific local and community based organisations to help shape outcomes. This includes less formal arrangements that have established local resilience groups in collaboration with the Scottish Borders Council (Lyon 2015). These groups are often an extension of community councils which formally provide a mechanism for civic engagement at the community level, although in practice community participation more widely, and capacity to represent community interests, greatly varies (Jun 2013). The local government has also engaged with community planning partnerships, which encompass a number of communities, and which is being strengthened by the Scottish Borders Council by piloting a 'localities approach' which seeks to bring communities into local decision-making to improve local facilities and services (Audit Scotland 2013, Matthews 2014). This is partly in response to the Scottish Community Empowerment Act 2015 and to the challenges of austerity, where new ways of working with limited resources are required (Pugh and Connolly 2016). As such, existing relationships between local government and communities are changing and developing.

Table 1. Principles for resilience building (Fazey et al. 2018) and how they were incorporated into the SBCRC project design.

Principle	How this the essential approached in the SBCRC project
1. Enhance adaptability and flexibility	• Focusing on linking and working with local issues; • Developing and supporting new community groups to organise and develop community focused projects; • Providing opportunities for some participants to learn about participation and facilitation; • Encouraging ownership of learning and decision-making and enhancing learning about complex issues through system and futures oriented workshops; • Enhancing and building relationships and bridging social capital across actors and organisations
2. Enhance resilience to specified and issues, shocks and stressors	• Focused discussions in first stage workshops to identify key shocks and stresses and their relationships, including issues such as impacts of potential food price rises, higher frequency and intensity of extreme weather events, and potential policy changes. • Development of understanding of systems dynamics of community resilience and disadvantage; • Taking a systemic approach to understanding climate disadvantage and resilience and how to work with this. This included developing qualitative systems models of community dynamics and how these affected community needs and aspirations and exploring both mitigation and adaption to climate change • Taking a systemic approach to understanding climate disadvantage and resilience and how to work with this. This included developing qualitative systems models of community dynamics and exploring key feedbacks affecting communities and exploring both mitigation and adaptation in integrated ways
3. Enhance horizontal working across sectors and issues	• Examining linkages across different sectors (e.g. food, poverty, water, environment) in the first workshop; • Developing relations across organisations representing different sectors and with communities through encouraging diverse involvement of different actors in the project; • Bringing together diverse stakeholders in workshops to highlight and work with cross-sectoral issues (e.g. land use change, community development, flood risk and emergency management, and renewable energy)
4. Enhance vertical working across social scales	• Examining and working with linkages between family level issues and community level dynamics; • Examining challenges in communities as a systemic issue and using this to develop thinking about national policy environments to support community resilience; • Working with national policy actors to identify key opportunities for creating a more enabling policy landscape and environment conducive to resilience at community levels.
5. Reduce carbon emissions through systemic approaches	• Developing and supporting carbon reduction projects (e.g. energy renewable schemes in Hawick) as part of the action oriented work in the project; • Focusing on climate change as a wide and systemic issue.
6. Build climate literacy	• Direct and explicit focus on climate change in workshops that encouraged wide conversations about climate change, but in ways that drew out its relevance to local issues.
7. Engage directly with futures	• Use of the Three Horizons approach in the second (and sometimes third) workshops to frame current challenges in relation to future desired possibilities and to identify intermediate steps to help get there.
8. Focus on climate disadvantage and reducing inequalities	• Explicit and direct focus on identifying those most disadvantaged by climate change. This included, for example, building understanding of the systemic nature of resilience at community levels from the perspective of climate disadvantage. • Development and discussions of disadvantage and resilience at group, community and national policy levels;
9. Encourage participation, learning and empowerment	• The entire project was focused on delivering a process of engagement and community activities; • Use of expert facilitation and process design and implementation was built around flexibility and participation; • Emphasis on dialogue, relationship building and on community ownership and participation through application of a strategy of community engagement; • Reflexive and iterative process of learning embedded in the process.
10. Focus on transformative and systemic change	• The project continually sought to encourage collaborative thinking and work focused on interconnections. While there were limited opportunities to genuinely work towards deep and significant forms of change, the project sought to gradually build relations, trust, capacities for collaborative working through its focus on the nine other essentials to lay foundations for deeper conversations and work to occur

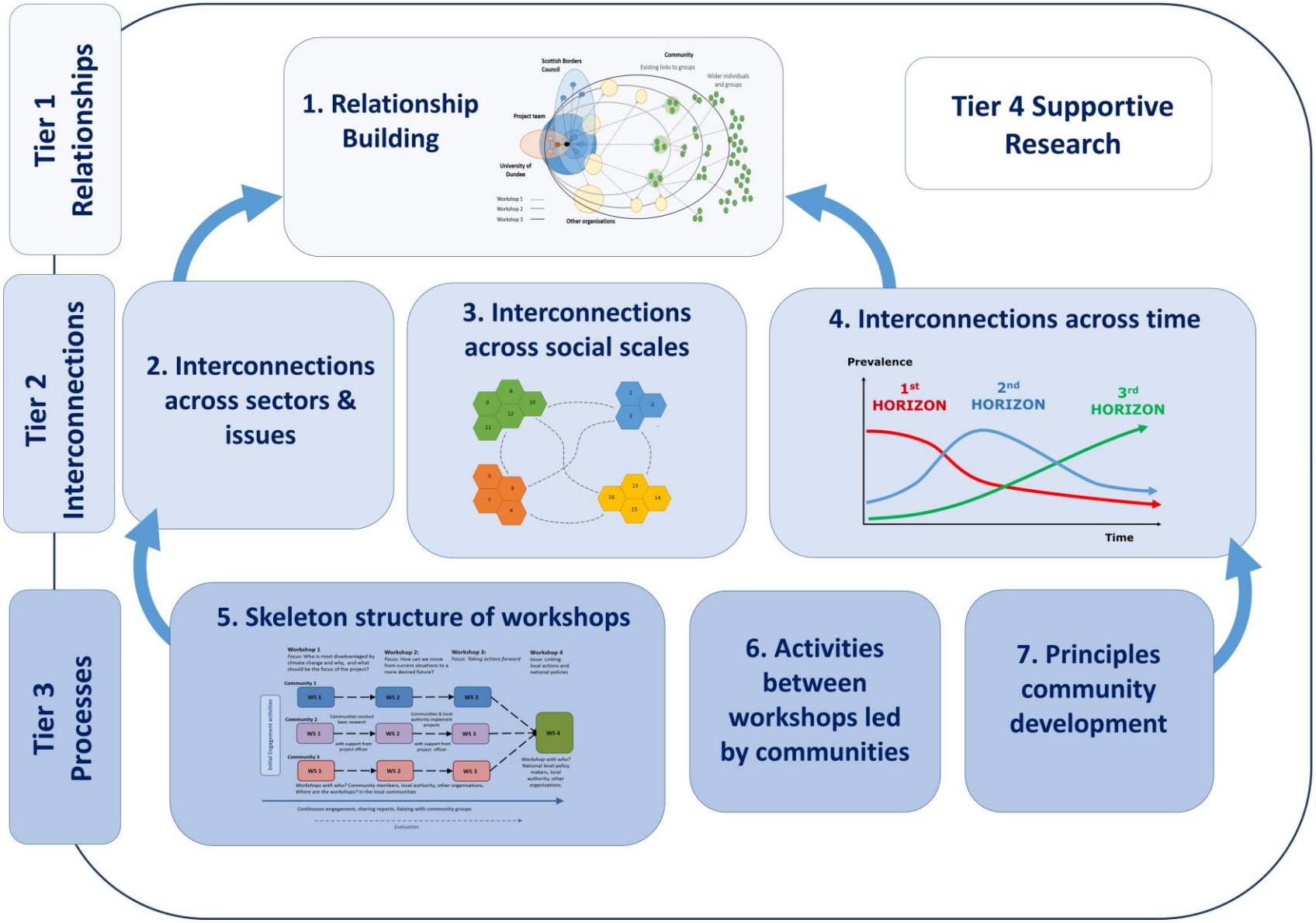

Figure 1: The four-tiered community resilience building process implemented in the SBCRC project.

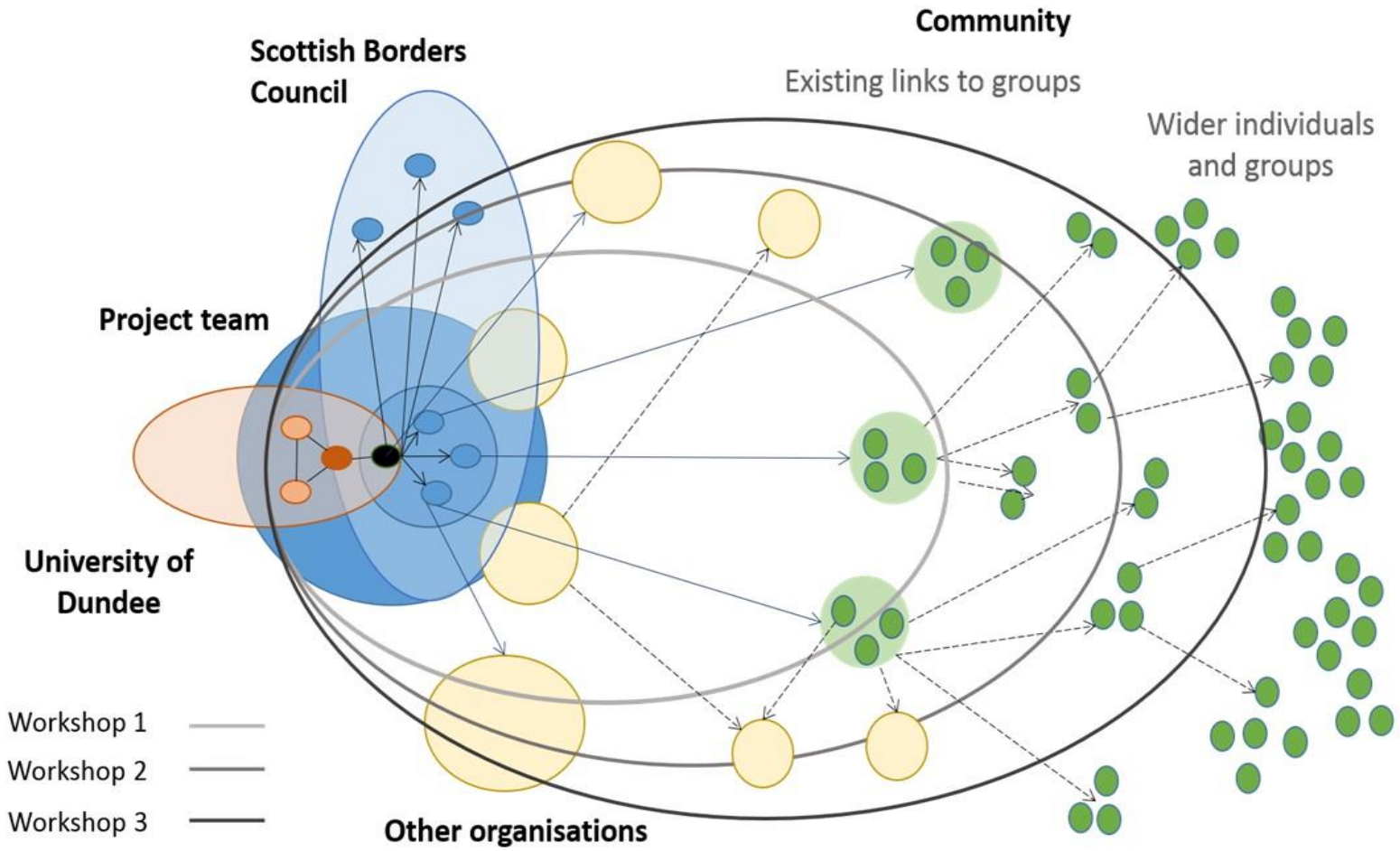

Figure 2: Processes used to enhance and engage with different stakeholders and community based participants.

Tier 2: Interconnections

In line with many studies which highlight the importance of considering interconnections and system dynamics in resilience (Allison and Hobbs 2004, Gallopin 2006, Berkes and Ross 2013, Wilson 2014), the second tier focussed on exploring, learning and developing collaborative action that considered interactions across: (i) issues/sectors, (ii) social scales and (iii) time (Figure 1), ultimately with the goal of reducing vulnerability of those most disadvantaged by climate change.

While holistic thinking, where all things are considered to be interconnected and interrelated, is a fundamental basis of the theory of resilience (Helfgott 2018), this framing is often not applied in practice (Wenger 2017). The SBCRC project therefore encouraged participants to continually expand the notion of the system boundary to help participants move beyond silo-based perspectives and develop systemic oriented solutions. While it is not possible to be fully comprehensive (Helfgott 2008), relationships across sectors and issues were explored in workshops with participants in depth to help them develop systemic understanding of about the nature of problems and solutions and help change how decisions about what actions to take forward and how to achieve them were framed.

The second tier also worked with interconnections across social scales (Wilson 2013, Chandler 2014, Wilson 2014, O'Donnell et al. 2018). This included relations at family, community, and wider national scale policy environments. To understand relations between community and national levels, 24 participants from national level government and non-government organisations examined findings about community dynamics to identify what a synergistic policy landscape would look like that could more effectively support community resilience. Participants in this process had diverse expertise, including about poverty and disadvantage, community development, climate change, flooding, emergency planning, rural development and environmental management.

Systemic change requires creative approaches that attend to the interconnections across time between actions in the present and the emergence of an aspirational future (Tschakert et al. 2014, Sharpe et al. 2016, Tschakert et al. 2016). The SBCRC project therefore also focused on mapping possibilities for transformational change using the participatory Three Horizons method (Sharpe et al. 2016). This was underpinned by a strength based approach (Helfgott 2008) which, rather than focusing on identifying problems, sought to empower participants by asking what actions would generate success and what resources existed that could help achieve it. The strength based futures method then resulted in a set of actions for resilience building that took into account the complexities of community life, the different needs and desires of those involved, and the need for systemic change (Figure 2).

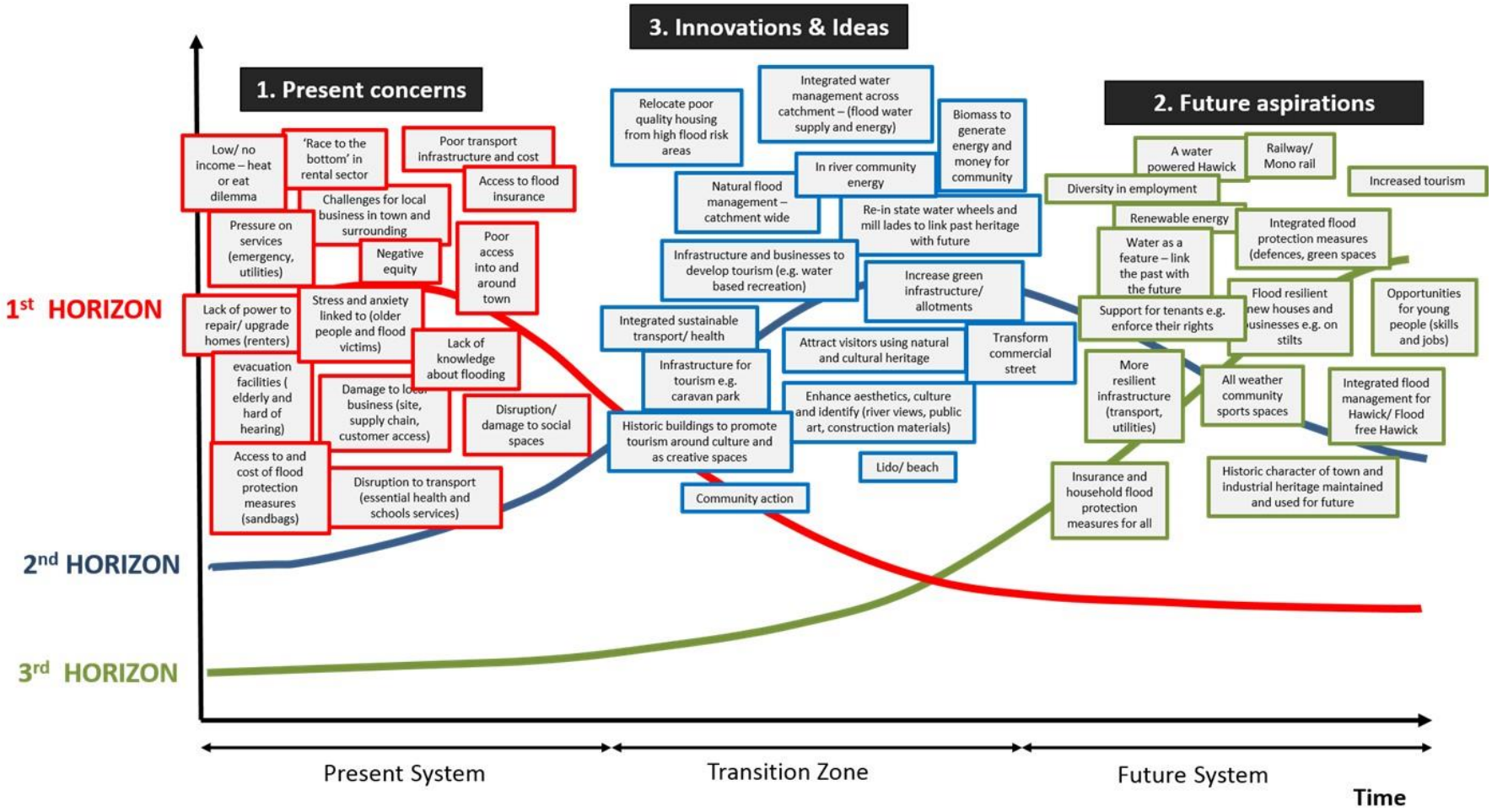

Figure 2: Example of a futures oriented map from one of the communities (Hawick) about how to achieve systemic pattern shifts through modifying flood defence designs. The primary shift in this case was from immediate concerns about flooding (red boxes) towards much more holistic perspectives of what development and resilience should focus on, such as more broadly towards community regeneration (green boxes)

Tier 3: Process design and implementation

The third tier supported tiers one and two by guiding how the project was implemented. This included supporting leaning through exposing participants to the diverse perspectives and expertise of others. The design included applying: (a) a flexible structure of engagement and interaction between stakeholders (Figure 3); (b) collaborative actions; and (c) principles of participatory community development.

First, resilience building requires a balance between providing sufficient direction and flexibility to local interests and needs (Mog 2006). A skeleton structure of three professionally facilitated workshops were thus held in each community with different actors and organisational representatives which provided more formalised spaces to convene dialogue and share perspectives (Figure 3). The first workshop (repeated in each community) worked with participants to explore shocks, stressors, complexities, uncertainties, and climate disadvantage, developed a sense of direction for action, and identified key community dynamics and leverage points (Meadows 2000, Abson et al. 2017). The second workshop mapped potential future visions, aspirations, and began to co-create actions and plans (Figure 2), and the third provided a facilitated space to examine how to take agreed actions further forward to address context specific needs framed within a wider systemic level understanding.

Second, the project involved actions led by community members with support from the project officer, which included further relationship building, support for community members to undertake research in their own community, mediation between actors by the project officer; support for project planning; regular reflexive meetings and specific actions to enhance resilience.

Finally, the process involved balancing diverse needs, such as provision of direction and community ownership, and meeting both funders and community's needs and expectations (Parfitt 2004, Mog 2006). As such, principles of community development to enhance participation and project implementation were applied (Table 2) to enhance collaborative and cross sectoral action and to support the first two tiers.

Tier 4: Action oriented research, learning and reflexivity

Resilience-building is enhanced when supported by an active and iterative learning process, where information about issues and the process are continually fed into projects and where underlying assumptions can be challenged and considered (Ashley et al. 2012). A supportive research process was therefore embedded within the SBCRC project to help guide decisions and to stimulate reflexivity, action and change. This involved a skilled project officer who acted as both implementer and researcher and continued reflection by the project team as new information and ideas emerged.

The research aimed to achieve two outcomes: (1) Support the project by iteratively feeding in new insights as they emerged and (2) providing new information about resilience-building as a a social and dynamic process. For the latter aspect, four different kinds of data were used (reflective diary, interviews, evaluation of community based workshops, and reflective workshops with team members. This data was analysed using three main iterations. In the first iteration open and axial coding identified activities, learning outcomes, tangible and capacity building outcomes, different types of influencing factors, and opportunities. This was then used to construct detailed timelines for each community, enabling contribution analysis (Mayne 2011) to be used to assess relative influence of different factors on how each of the community projects unfolded. In the second iteration, timelines and contributing factors were critiqued and refined by the whole of the project team in a reflexive workshop. This provided deeper insights about the commonalities and differences between the community projects and emergence of an initial grounded theory about the social dynamics involved, which was then tested and refined in relation to the more formalised data sources. The third iteration

involved further refinement by the project's advisory board and further triangulation. The final grounded theory was represented as a causal loop diagram (CLD)(Sterman 2000) to show key influences and feedbacks and establish insights about the overall dynamics involved.

A critical aspects of the research process was ensuring the work was reflexive. This enhanced ability of those involved to continuously reflect on how the embeddedness of researcher-participants influenced how they were understanding what was happening and why and to help inform the project as it progressed. Reflexivity was enabled in five main ways:: (i) iterative collection and analysis of data; (ii) active critical reflection through diary writing to surface implicit assumptions; (iii) reflexive monitoring where assumptions were challenged through regular, but separate, meetings between the project officer and with the project lead, the evaluator and the local authority lead; (iv) reflexive meetings and workshop with the project team as a whole that were professionally facilitated to probe perceptions and findings; and (v) through interviews with team members by the external evaluator, which helped members reflect on their role and project progress.

Figure 3: Structure of the process, based around three workshops in each community with activities conducted inbetween each workshop.

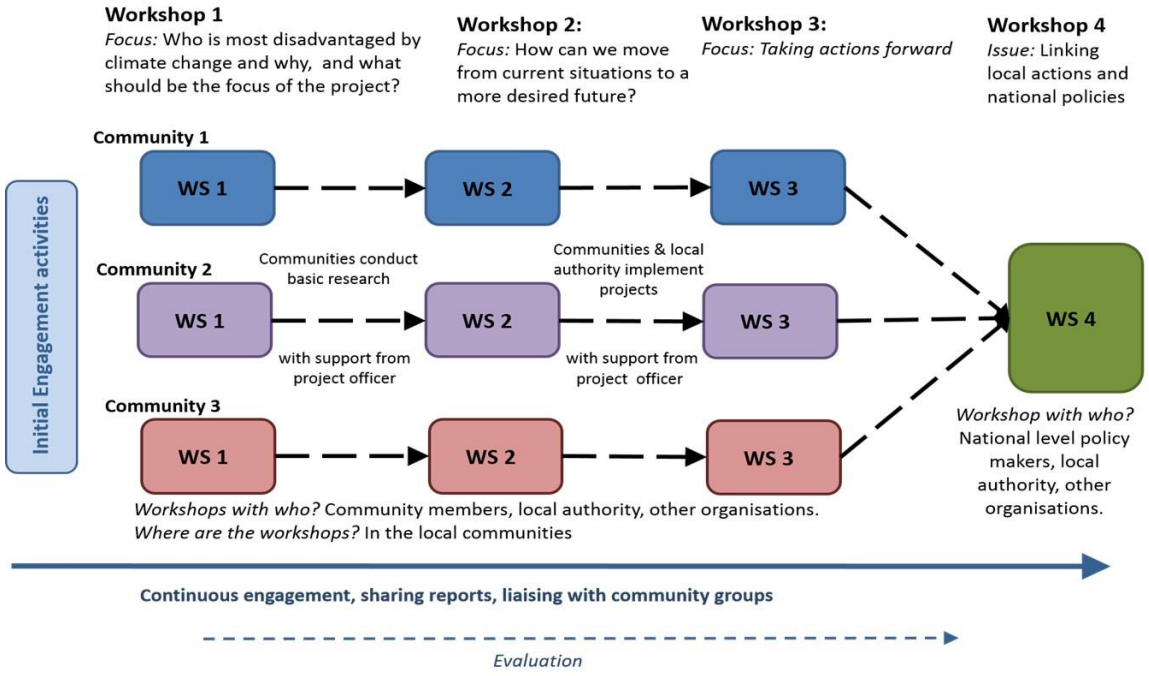

Table 2: Principles from participatory community development operationalised in the project (Chambers 1997, Parfitt 2004, Mog 2006).

Principle	How the principle was operationalised
11. Maintain local focus	The project officer was immersed within the social setting to enhance understanding of the challenges and concerns of the council and local communities.
12. Strengthen collaborations	Engagement routes through the project team organisations were used and team members' involved in workshops as participants.
13. Provide spaces for dialogue with flatter hierarchies	While the project was led by organisations external to the communities, significant attempts were made to build relations and provide spaces for dialogue that could encourage participation and collaboration. This included workshops being primarily facilitated by researchers and/or professional facilitators whereas other team members (e.g. project officer, Council Staff, other organisations) engaged in the workshops as participants alongside community members. This sought to help provide spaces which reduced the top down nature of the project and which could encourage meaningful dialogue.
14. Flexibility in objectives	Identifying common objectives and shaping the project to increase the perceived added value to local communities and the Scottish Borders Council. For example, in Peebles the final workshop was shaped around the development of a Community Resilience group. This aligned with the goal of some local people following severe flooding in December 2015 and with the pre -existing goal of the council's Emergency planning team.
15. Flexibility in focus	Adapting the project to focus on locally relevant issues, which differed across the three communities and emerged as the project progressed.
16. Flexibility of the process	Allowing the overall process to be adapted as understanding of the local and council needs developed. For example, the project involved interviewing participants about the process and feeding this back to the project team to encourage reflection and learning. This led, for example, to significantly altering Stage 3 workshops.
17. Flexibility in workshop design and facilitation	Adapting the design of workshops depending on changing needs of the project. For example, the Three Horizons method was used in the second workshop in all communities but was modified depending on specific issues emerging from the communities.
18. Be clear about what was possible	While the project aimed to provide meaningful opportunities for people to shape outcomes it was important to be clear about what was possible to avoid raising expectations. For example, discussions to engage people were undertaken with a wide range of organisations and individuals to explain the project, the process and outcomes. Emphasis was placed more on action than research. Involvement in the project was linked to an ability to help shape outcomes through the process.
19. Be iterative and reflexive	Listening feedback, applying learning to adapt practices and ensure flexibility. This included regularly 'stepping back' from the process to critically examine the implications of the behaviours and activities of the project officer. For example, following each community workshop a well-structured report was written which outlines the process, the discussions in the workshop and the agreed next steps. These reports were emailed or posted to participants who were asked for feedback. Bi weekly discussions were also held between the project officer and the project manager to discuss progress, challenges, ideas and next steps. A core element of these discussions was critical reflection.
20. Strive for credibility and relevance	Ensuring the project process was perceived as adequate to deliver the stated aims and objectives. This is an essential aspect of working with communities and other stakeholders in a participatory way. For example, the skills of the funders and the different project partners was explained by the project officer to those engaged and these were then modified in a flexible manner to meet community needs. An advisory board was also used gain the views of external experts to help increase the degree to which findings could be made meaningful to other policy and more generic contexts.
21. Take a systemic approach	Recognise and embrace the complexity of the challenges and inter-relationships of issues and people. For example, to initiate discussions a range of known climate change challenges were used in the first workshop to examine the local impacts of climate change.
22. Be legacy oriented	Seek to contribute to a wider, on-going process of engagement and action and support key people to develop future initiatives. For example, much of the process focused around relationship building. In Hawick, the project officer also supported the community based renewable energy group to include more local people and to take steps to develop closer collaborative working with the river culture thematic groups and create a renewable energy initiative alongside the flood scheme.
23. View project as longer term learning journey	Overall, the project was viewed as being part of a longer term learning journey. This meant 'learning' became as a key focus in the project as well as achieving specific actions and outcomes. This maintained emphasis on: (a) Recognising that not all aspects were important but that learning how to do change was critical; (b) orienting workshop design and targeting engagement activities; (c) reflexion - i.e. continual consideration of local and council needs, how well the project was working and balancing needs for considering systemic and holistic aspects of the project while also providing focus.

Table 3: Ten essentials for second order climate research and how they were operationalised

Essential	How it was applied in the SBCRC project
24. Focus on transformational change	Second order climate change research requires a focus transformational responses, such as understanding or generating impact on systemic, structural, cultural and normative change. For this project, enhancing resilience was approached as a process of change involving both mitigation of carbon emissions and adapting to the impacts of climate change, which in turn requires analysing and working with the systemic aspects of communities and climate change. The whole project therefore revolved around addressing and working with systemic aspects and finding ways to work with or challenge these.
25. Focus less on problems and more on solutions	The project focused on action rather than being primarily focused on producing knowledge, from which action is often implicitly assumed by researchers to emerge. The action then gave opportunities for learning both about the systemic issues involved and developing wider lessons about delivering resilience as a practice (this paper).
26. Develop practical as well as epistemic knowledge	In addition to learning about the systemic nature of community resilience, such as through eliciting expertise through workshops and interviews, the project sought to develop know-how knowledge about implementation. This emerged as two main forms: First, development of the embodied knowledge of project team members and participants, such as better know-how knowledge relating to skills in facilitation, participation and community engagement, relationship building and system change. Second, the work produced know-how knowledge presented in epistemic form, such as that in reports and this paper.
27. Approach science as occurring from within the system being intervened	The project officer was directly embedded in local government and worked directly with community groups to provide them with support for taking actions forward. All project members were also embedded in the project, playing different roles in shaping the project outcomes which enabled them to have a more intricate understanding (albeit from different perspectives) about what was happening and how action and change was unfolding and could be stimulated.
28. Work with normative aspects	Working with contemporary challenges like climate change requires researchers to be aware of their own values and assumptions driving the research and finding ways to work a plurality of values of others that affect both the knowledge produced and the action-oriented outcomes achieved. This was achieved through delivery of a highly flexible co-creation process with diverse stakeholders and in participatory ways. Different values and thinking often surfaced in workshops, meetings and interviews, which were also designed to provide spaces for dialogue and debate. This included engaging with different mindsets held about the relationship between present actions and future, aspirational change.
29. Take a multi-faceted approach to understanding and shaping change	Different ways of understanding were explored and developed through the project. While the project largely focused on understanding social complexity (e.g. relationships, social capital), it also sought to integrate this with more physical aspects of complexity, through developing qualitative system models. Use was also made of different ways of knowing, such as through local expertise, professional expertise, as well as codified forms of knowledge, such as reports.
30. Acknowledge the value of alternative roles to accelerate learning	To enhance learning, it is sometimes necessary for researchers to take on different roles other than through being an observer. In this case, all researchers were involved in some way in helping to create action, such as by being facilitators, mediators, connectors. Those on the project team who were not form a research background also often engaged in research, including collection of data or interpretation of results. The mixing of roles was recognised as being both essential for delivery of action and to enhance development of different forms of practical and epistemic knowledge.
31. Embrace and encourage second order experimentation and change	The project was itself an experiment in implementing resilience in practice. The experimentation involved: (i) Integration, where external knowledge was incorporated to inform interventions and actions (e.g. about design and during implementation; (ii) trial and error, where new actions (e.g. for community engagement) were improved and developed when working within different communities; (iii) repetition of activities, such as across different communities.
32. Seek new ways to challenge and generate new insights	The project was focused around developing different ways of thinking using different tools and approaches. For example, the futures method helped participants develop new ways of looking at the future and how change emerges, while the systems approach that was used with participants helped them develop more creative and effective solutions. In many cases this challenged the thinking of the participants, as highlighted through interviews conducted with them about their learning journeys.
33. Be reflexive	Reflexivity in the research process is essential to consider how those involved in the research are affecting perceptions and learning about the knowledge being produced. To address this, reflexive activities were directly embedded into the research process in two main ways. First, given the key role of the project officer in the project, attention was given to ensuring there were regular spaces and mechanisms for reflection, such as: directly with the project lead or project team members; through keeping a reflective diary; and through analysis of emerging data and trends that then informed her activities. Second, reflective spaces were provided for the team as a whole, including in pre-determined meetings and small workshops where data from interviews and workshops fed into the reflexive process.

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