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Risk and resilience management in co-production

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Introduction

In the twenty-first century ideas and practices of resilience have become a central organising metaphor within policy-making processes and the expanding institutional framework of national security and emergency preparedness. For many, resilience offers an integrated approach for coping with all manner of disruptive events, as well as a new way to engage with future uncertainty (Coaffee, 2019; Walker and Cooper, 2011; Zolli and Healey, 2013; Chandler, 2014). As we will argue in this chapter, resilience-thinking has subsequently been utilised to ‘extend’ established risk management approaches and methodologies and to advance ways of surviving and thriving in the future through adaptation and long-term transformative action. Here we view resilience as a new approach to governing complexity and as a supposed antidote – a new *biopolitical nomos* - to such destabilisation and insecurity, in contrast to a conventional probabilistic ‘risk-based’ world. In such new governing assemblages, co-production has emerged as a key process in terms of how risk is assessed and acted upon. Here we see co-production as about developing equitable resilience outcomes through a process of shared dialogue between different stakeholders, including local communities. As we have argued elsewhere, the building of such resilience is about new forms of joined-up governance which will be ‘most effective when it involve[s] a mutual and accountable network of civic institutions, agencies and individual citizens working in partnership towards common goals within a common strategy’ (Coaffee, et al, 2008, p. 3).

Increasingly, the focus of resilience policy is being directed towards smaller spatial scales and everyday activities nested in the local area, necessitating a broader historical and intercultural understanding of how individuals, communities and organisations respond to change by developing or enhancing resilience. From this perspective, building the resilience of the individual, institutions and the neighbourhood is the pathway to resilience of the whole. In the context of place and communities, it is thus the social consequences or ‘the

ability of communities to withstand external shocks to their social infrastructure' (Adger, 2000, p. 347) that is arguably of greatest significance and concern. In contrast to traditional approaches to risk management, which have relied upon a narrow range of governmental stakeholders, contemporary and future schemas are looking to draw a full range of individuals, professionals and community groups into decision-making at a range of spatial scales.

In many respects, such localised resilience practices mirror broader trends in public governance of the past twenty years where the regulatory state 'steers' via strategy and the 'rowing' of implementation is carried out locally (Osborne and Gaebler, 1993). Here, resilience practices become nested in the local area, providing a fit with wider Government ambitions to create a new, more community-driven, social contract between citizens and the state (Coaffee, 2013). As a result, resilience approaches become realised not through state institutions, but upon localised networked responses, with governance dispersed more widely across key stakeholders and sectors. This, as Bovaird and Loeffler (2012; 1121) have highlighted, has placed an emphasis on user and community co-production of public services and outcomes and where top-down approaches are blended with bottom up viewpoints with 'professionals and citizens making better use of each other's assets, resources and contributions to achieve better outcomes or improved efficiency'.

The shift towards localised resilience approaches is also not without critique. Much of this critical assessment concerns the alleged tarnishing of resilience ideas through neoliberal decentralisation and a post-political landscape understood as the foreclosing of political choice, the delegation of decision making to technocratic experts. The emerging canon of work in 'critical resilience studies' has highlighted the ways in which resilience policy and practice indicates a shift in the state's policies, reflecting a desire to step back from its responsibilities to ensure the protection of the population during crisis and to delegate to certain professions, private companies, communities and individuals. Through the lens of resilience policy, we can arguably chart new forms of precautionary governance, attempts to create resilient citizens, the drawing in of a range of stakeholders to the resilience agenda, and the corresponding adoption of new roles and responsibilities in enacting policy priorities. Whilst we are sympathetic to critical accounts and especially their powerful

expose of who wins and who does not in neoliberal governance, we prefer to focus our analysis on a more inductive and performative approach that views resilience as a multiplicity of related, and often-experimental practices. Like Brassett and Vaughan-Williams (2015, p.34), in this chapter we 'seek to reflect and develop upon a notion of resilience as an ongoing interaction between various (and often conflicting) actors and logics, one which can be viewed as far more contingent, incomplete and contestable in both its characteristics and effects than is usually acknowledged in the existing literature.'

Moreover, previous research has revealed that the implementation of resilience is not neutral and urges us to consider the significance of the instigators, beneficiaries, and objectives of measures that are ostensibly designed to increase resilience. Increasingly, with talk of resilience offering the potential for radical and transformative social change, there are coinciding calls to reflect upon issues of social justice (Ziervogel et al., 2017; Turnhout et al 2019) and to ask how we can ensure that the rolling out of resilience is even-handed and produces outcomes that are more equitable? We thus have to ask how existing systems of governance are ensuring that marginalised voices are incorporated in decision-making and the construction of resilient futures? Whilst there is much discussion regarding the capacity of resilience to promote safer development, concern has been expressed that the techno-managerial frameworks that measure and monitor development operate according to rigid, quantitatively defined parameters which do not consider local variation and intra-urban inequalities, and, in effect hardwire such inequitable processes into future decision making (Ulbrich et al 2019). This has stimulated calls for approaches to recalibrate conventional methodologies to account for this differential socio-spatially determined vulnerability to natural hazards, especially in the global south, and to embrace more collaborative and co-produced ways of working and assessing.

Within this context of the turn towards resilience as an antidote for risk, crisis and uncertainty, over many years we have collectively evolved a range of mixed-methodologies to explore how resilience has changed the way in which society and policy-making communities have responded to emerging risk and how the governance of risk has transformed. We have looked at how risk management has morphed into concerns with

resilience through a paradigm shift in critical infrastructure protection approaches across Western Europe where social and organisational issues are now increasingly taken into account (Coaffee and Clarke, 2016). Similarly, we have looked at how the resilience of communities and public spaces against terrorist violence in the UK can be enhanced by dialogue between security actors and civil society groups (Coaffee, 2013) and, how greater community engagement and the incorporation of volunteered geographic information in risk-based decision-making has been central to advancing bespoke urban resilience strategies for earthquake and flood-prone neighbourhoods across Europe (Pitidis et al 2018).

Across all these and other projects, to be transformative and empowering, new or complementary methodological approaches are needed to engage the local residents more inclusively than conventional data sourcing methods such as censuses and household surveys or traditional risk assessments allow. To further unpack this dynamic whereby we can integrate citizen-driven data with official data sources, this chapter will explore an ongoing co-designed and co-produced project we have been engaged in, in poor local communities in Brazil that are at severe risk of flooding. Here in our *Waterproofing Data* project we have adopted emerging methods, such as participatory mapping and citizen-generated data into decision-making processes and begun to bring about transformation in the ways in which the governance of flood resilience is conducted and made more equitable. *Waterproofing Data* brought together an interdisciplinary group of researchers and institutions from the three collaborating countries (United Kingdom, Brazil and Germany) in coordination with Belmont Forum's "Transformations to Sustainability" programme (project grant ES/S006982/1) that ran from 2018-2021. The project gave a prominent role to local data collection and community resilience, as well as its connection to holistic disaster risk management as articulated in recent international development such as the 2015 Sendai Framework for Disaster Risk Reduction and the Global Partnership for Sustainable Development Data. The Sendai framework, for example, emphasized a renewed commitment to promoting the local assessment of risk of disasters in order to enhance implementation of disaster resilience and to build back better. This framework also sought to stimulate concerted effort to foster collaboration and partnership institutions and enhance the implementation of equitable resilience policies and practices.

Framing resilience as co-production

The UN Habitat dialogue note *Raising Standards of Urban Resilience* (2014, p.2) highlighted the imperative to develop tools and methodologies aimed at providing a measurement of urban resilience that would underpin more equitable urban development. However, as they are currently arranged, disaster risk reduction and resilience policies usually frame risk in ways that are not sensitive to the local reality of marginalised urban neighbourhoods, and are thus unable to capture highly localised aspects of such neighbourhoods. In particular, they overlook the human/social aspects of vulnerability and factors relating to local physical infrastructure that are crucial for effective reduction of the economic and human costs of natural hazards.

This has become a particular issue in Latin America, which has undergone accelerated urban growth in the past 50 years and it is presently one of the most urbanised areas of the world. One consequence of this trend is the proliferation of marginalised urban neighbourhoods which are not only disproportionately exposed to natural hazards, but also have less economic and social capital to adapt and respond to their consequences. This has led to a number of initiatives designed to anticipate and manage risk more effectively so as to reduce the impact of disasters. However, a noticeable implementation gap in the delivery of equitable resilience is evident. This is not only attributable to a lack of resources, but also to highly complex social, economic, political and institutional reasons where there is a disconnect between official risk management and development policy and the differential needs of people in marginalised groups.

In response to these concerns, the *Waterproofing Data: engaging stakeholders in sustainable flood risk governance for urban resilience* project has adopted an innovative methodological approach, analysing data in novel ways in order to generate new knowledge and stimulate new practices that might improve disaster resilience for all. Our approach to data draws from and extends the established literature emphasizing the significance of big data and digital technologies in the transformation of urban life (e.g. Batty, 2013, Chourabi

et al. 2012). Most of this work approaches data in a conventional way, as something generated by scientific and other digital devices and sensors, to be fed into centralized systems and then acted upon and used for decision-making by scientists, members of government and other authorities. Arguably, such data practices are reliant on long-held quantitative modelling tools that provide broad and scalable baseline measure that might be of interest to policy makers, but are currently developed at a level of abstraction that does not fully account for local context and citizen engagement. As such, to better understand the complex dynamics of risk, resilience and development requires a mixed method approach involving quantitative and qualitative measures to study communities in situ and to combine this with a generalised framework that provides a relatively aggregated picture of exposure to shocks and stress. Here Cutter et al. (2010) have argued that in advancing indexes for measuring resilience ‘baseline indicators provide the first ‘broad brush’ of the patterns of disaster resilience within and between places and the underlying factors contributing to it’ and that ‘a second step is a more detailed analysis within jurisdictions to assess place-specific capacities in each of these areas (social, economic, institutional, infrastructure, community) and the development of fine-tuned and local appropriate mechanisms for enhancing disaster resilience’ (p.18). Assessing the management of resilience thus requires both a qualitative in-depth understanding of communities alongside longitudinal analysis to track vulnerable groups exposed to risk linking the interaction of people to hazards across time and space to ensure spatial and social justice (Coaffee and Lee, 2016).

To extend conventional and top-down data and assessment practices, and to reframe resilience as a dynamic policy mechanism to manage complexity and transform governance processes rather than a conservative practice and outcome of good development, in *Waterproofing Data* we focused on the active role of citizen-generated data and how this might be hybridized with official data set and risk models. Our approach seeks to use a combination of top-down and bottom-up approaches to collect and collate data proactively to build ties between the different stakeholder groups linked to environmental risk events in our study areas in Brazil.

More specifically, *Waterproofing Data* investigates the governance of water-related risks, with a focus on social and cultural aspects of data practices. Typically, data flows up from

local levels to scientific "centres of expertise", and then flood-related alerts and interventions flow back down through local governments and into communities. Rethinking how flood-related data is produced, and how it flows, can help build sustainable, flood resilient communities.

To this end, we developed a range of innovative methods around data practices, across different sites and scales. These methods are related to three core objectives:

1. Making visible existing flows of flood-related data through tracing data.
2. Generating new types of data at the local level by engaging citizens through the creation of multimodal interfaces, which sense, collect and communicate flood data.
3. Integrating citizen-generated data with other data using geo-computational techniques.

In essence, these methodological interventions have the potential to transform how flood-related data is produced and flows, creating new co-produced governance arrangements between citizens, governments, and flood experts and, ultimately, increasing community resilience related to floods in vulnerable communities of São Paulo and Acre, Brazil. Moreover, our approach sought to overcome current siloed framings of risk and poverty/development by widening the understanding of risks and enhancing local capabilities through an innovative, transdisciplinary research approach that addressed how multi-stakeholder engagement of disaster-prone urban neighbourhoods can expand the understanding of risks, vulnerabilities and capabilities to integrate risk reduction and local sustainable development, in more equitable ways. In posing this question, we attempted to reverse conventional perspectives on disaster risks that are primarily based on decontextualized, exogenous models and definitions of risks and development, which fail to capture the particular realities of urban poor neighbourhoods. Instead, we adopted a dialogic approach inspired by the *Pedagogy of the Oppressed* developed by the Brazilian educator Paulo Freire (1970) in order to develop an approach that reframes citizen sensing as a critical pedagogical process (de Albuquerque, & de Almeida, 2019). This approach enables us to centre on the engagement of residents of urban poor neighbourhoods in a process of research co-production together with a multi-disciplinary research team

(including engineering, environmental scientists and social scientists) and stakeholders of local governmental and non-governmental organisations involved in disaster risk reduction and local development.

The *Waterproofing Data* project provided a new perspective on ‘sensing’ in citizen science by entering into a dialogue with local communities. In addition, our critical pedagogical approach paved the way to establishing new methodologies and ethical-methodological criteria for participatory research and practices in citizen-generated data and citizen science. These should not replace the existing concerns/framings about validity (e.g. on the quality of the generated data and its ability to serve as scientific evidence) but rather, supplement them. Initiatives that are based on citizen-generated data start with an encounter between two roles: the scientist (or project leaders) and citizens (or data generators). We established an analogy between these two roles and the roles of the pedagogical process: educator and learner. This analogy allows us to draw on concepts from Freire’s critical pedagogy to reframe citizen sensing and, as a result, reveal an underlying ‘constitutive tension’: the asymmetric condition between scientists and citizens requires an openness and willingness to face the risk of Otherness so as to be truly inclusive (ibid). Understanding the participative production of data from this perspective, means that *relationship* between scientist and citizen is established as a dialogical process, in which the *modes of engagement* between citizens, scientists and digital technologies which can lead to empowerment, rather than a purely instrumental activity that originates from the asymmetric roles of scientists and citizens and from the differences in their cultural and epistemic practices. Our Freirean perspective is thus not only aimed at highlighting the perils of disregarding the different types of asymmetries and inequality in community-based or citizen science projects (e.g. with regard to education, gender, economic power, and worldviews), but also proposing a dialogical approach as a means of dealing with them in a productive way. This approach can enable new ways of carrying out research projects that are able to leverage the realities, worldviews and epistemologies of marginalised and disadvantaged people, which is likely to be particularly important in the ‘global South’. This approach can contribute to the establishment of empowering and ‘humanised’ dialogical relationships, and thus enable us to regain the confidence needed to collectively undertake truth-building processes for the co-production of knowledge.

With this approach, on the *Waterproofing Data* project we sought to expand the understanding of risks, vulnerabilities and potentialities by rethinking how environmental risk data is produced, how it is used, and how it might enable transformations that close the implementation gap by delivering enhanced resilience for marginalised communities. Furthermore, the methods and results of this case study were used as the basis for a transcultural dialogue with government organisations and local administration involved in flood risk management in Germany and the United Kingdom. The project produced novel knowledge and insights, enhancing the research capacity across the interdisciplinary fields of expertise of its co-investigators: urban resilience and urban geography, public administration, science and technology studies, risk and governance (social sciences); media studies and digital arts (arts and humanities); social informatics, geo-computation (engineering); risk models and hydrology (environmental sciences). Thus, this project has the potential to set a research agenda by acting as a model for future interdisciplinary research methodologies on building resilience to natural hazards through contributions in three major areas: (a) novel participatory and inclusive approaches that takes account of existing gender, economic and social inequalities to include the perspective of vulnerable communities through crowdsourced geographic information and citizen-generated data; (b) improved understanding and design of social processes of decision-making involved in monitoring and coordination; (c) innovative approaches to improve exposure models based on citizen-generated data and co-production of community-based risk reduction.

Facilitating co-production through dialogue

In the *Waterproofing Data* project, we focused upon citizen-generated data from a dialogic, critical pedagogical lens. Here citizen engagement is not merely a means to gather data, but an opportunity for social learning for citizens and researchers (de Albuquerque and de Almeida, 2019) through which both can acquire a new critical consciousness of the components of risks faced by marginalised communities and of how to improve flood resilience. Furthermore, this dialogue also engaged with the perspectives of environmental risk mapping and local government agencies, so that the data generated could be used as

trusted evidence to make resilience policy mechanisms more sensitive to the different forms of intra-urban inequalities that mediate vulnerability and resilience. This combinatory approach aimed to build horizontal and vertical ties between the different stakeholder groups linked to environmental risk in our study areas with a focus on how (new) data practices can underpin an enhanced understanding of risk to improve risk governance and achieve more equitable resilience outcomes.

From the outset, we engaged with marginalised urban neighbourhoods in the cities of São Paulo and Rio Branco, Brazil, which are situated in flood-prone areas to produce citizen-generated data that collaboratively and inclusively enhanced understandings of the local context, vulnerabilities and capabilities, whilst also generating evidence for advocacy and pro-poor policymaking. We adopted a dialogic co-production approach to citizen-generated data, which relies upon our well-established partnership with community-based initiatives in these areas as well as with governmental agencies involved in disaster risk reduction and local planning and development. More specifically, the *Waterproofing Data* project has proceeded in five interlinked workpackages (see Figure 1) that investigated our three research objectives through the development of innovative research methods, which operated across different sites and scales (a) the macro-level of “centres of expertise” on flood risk management; (b) the meso-level of local government administration; and (c) the micro-level of communities.

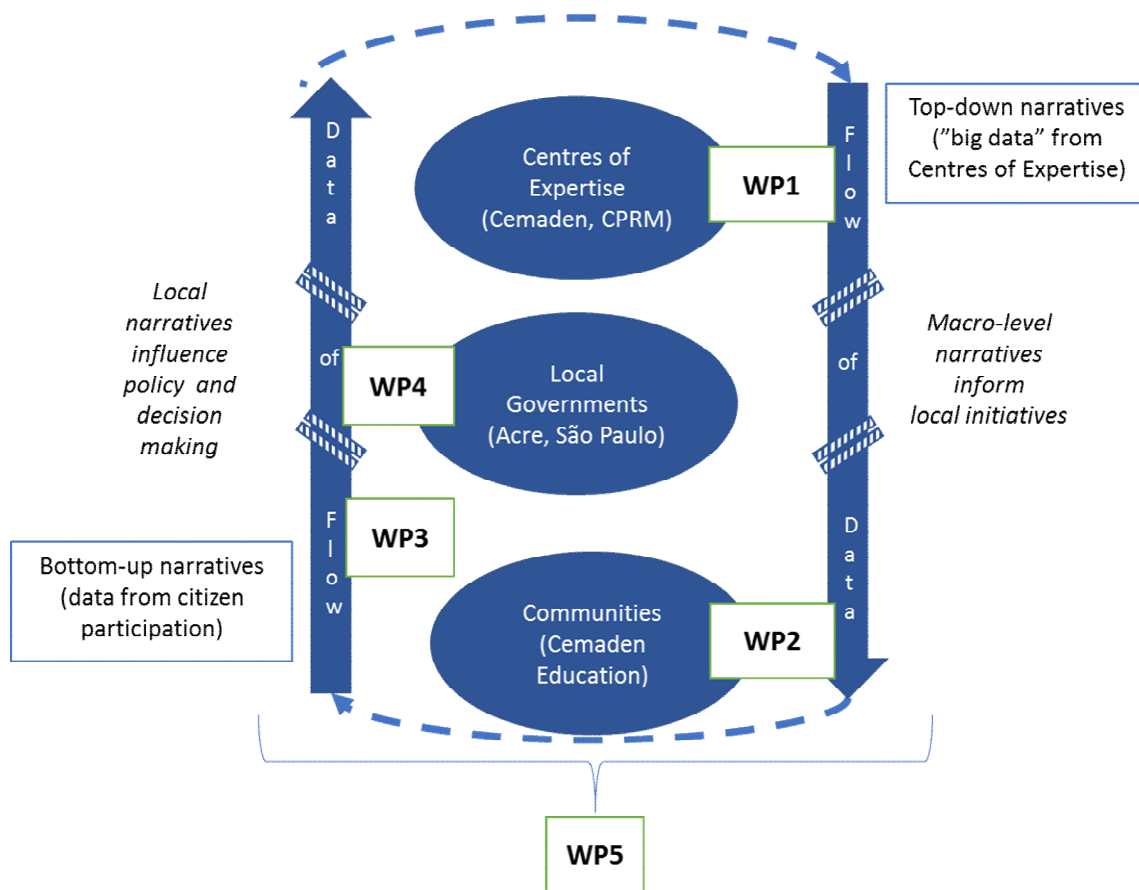


Figure 1. Scales and work packages of the Waterproofing data project

Workpackage 1, *Making data flows visible*, developed a method for making visible the existing data practices in the governance of flood events. The primary research site is the ‘centre of expertise’, CEMADEN (National Centre for Disaster Monitoring and Early Warning), which acts as a major hub or ‘centre of calculation’ (Latour, 1988) for current data related to the monitoring and alerting of flooding events in Brazil. With CEMADEN as a starting point, we will then follow the flows of data to two local government sites (São Paulo City Council, Acre City Government). Research in this work package revolved around the creation of *data diaries* at each of the three sites. Whilst diaries are a common method in qualitative ethnographic research, the novelty of our approach lies in gathering qualitative accounts through situated observations and interviews that elaborated existing data practices. The method was more than simple mapping in that it sought to make visible not only what data are used, when, and by whom, but also to account for data use over time as different people move in and out of the space. The method also sought to understand which data different decision-makers use and why within the context of monitoring and responding to flooding events at the levels of ‘centres of expertise’ and local government.

The creation of these diaries across these sites have allowed us to understand not only exactly how data flows within and between these sites, but also how these flows shape the capacity to act in relation to flooding events in site-specific ways.

Workpackage 2, *Community engagement through data circulation*, combines a number of humanities methods for engaging citizens through the creation of multimodal interfaces for sensing, collecting, and communicating of flood data (incorporating flood memories, narratives, and local/lay knowledges). Our methods have brought citizens' (their place-memories of flooding) and science (the geo-localization of flooding) knowledges together in new ways. We have engaged with intergenerational groups in local communities to produce not only data (which will flow back to the centres of expertise), but also to document local knowledge and enable skill/knowledge transfer within the communities. In particular, we have conducted focus groups within schools and with elderly communities to capture local narratives of flooding in our study sites. This workpackage therefore included intergenerational methods of knowledge production (through storytelling activities), knowledge sharing (through analogue and digital media/channels) and knowledge exchange (citizen-to-science-to-citizen). This has extended what flooding data can mean by illuminating experiences, myths, memories, collective knowledge, personal mediations, and anecdotes of flooding and flood risk.

Mapping cultures of flooding and flood risk entails daylighting a 'watery-sense-of-place' in Brazilian urban environments, and requires rethinking the relation and passages between cultural and scientific types of knowledge (Garde-Hansen et al 2017). As the project proceeded, creative processes will ensure this data emerged – as images, artefacts, text, visualisations, illustrations, animations, digital stories, off-road interviews, and videos. For example, many collective community memories of prior flooding events were captured and collected through a Flood Memory App and an online repository. Moreover, through this process, our longer term aim is to combine data generated through the Flood Memory App with both pre-existing data on flood risks and with new crowdsourced data generated by working closely with school children in citizen science projects (Trajber and Mochizuki, 2015).. The combined data sources will be used to create a number of data-driven environmental installations in flood-affected communities in both São Paulo and Acre, which will draw on

past experiences of making environmental phenomena visible through art. More specifically, these data-driven installations are aimed at mobilizing and sensitising wider communities to the intersection of place-memory and geo-localization of flooding data with the aim of transforming perceptions for improving community resilience and flood data literacy. In this context, co-produced knowledge processes highlight the variety and richness of tacit flood knowledge and help generate new types of flood-related data for the use and reflection of the affected communities and other stakeholders; and inform the integrative approach of workpackage 3.

Workpackage 3, *Integration and curation of data for decision support*, has developed a geo-computational method to integrate heterogeneous flood-related data of qualitative and quantitative nature from 'authoritative sources' from centres of expertise (workpackage 1) and citizens (workpackage 2). This method included developing data visualization interfaces that are able to support decision-making processes of different end-user groups at different scales. Our starting point for this work was to produce detailed maps of the communities studied by using collaborative mapping techniques based on the OpenStreetMap platform. These maps served not only provide a base reference layer where the critical infrastructure and people exposed to flood risks can be located (Eckle et al. 2016), but also allowed us to collect 'risk awareness maps' (Klonner et al. 2016). The first step in mapping the social infrastructure of the communities was based on very-high-resolution optical satellite imagery freely available in order to generate a base layer of geographic data (e.g. roads and buildings). This data was then used to print out paper maps that are annotated by citizens to provide information about community assets and their flood risk perceptions in specific areas in a way that is at the same time easy-to-use but also geospatially precise (de Albuquerque et al. 2019). The geographic data collected in this manner served as an additional level that allowed the integration of authoritative data sources on floods (e.g. sensors, risk maps), with the mainly qualitative data on flood memories generated and the qualitative and quantitative data revealed through our 'data diaries'.

When integrating the various qualitative and quantitative data generated in our work to date we have been careful to take account of the different criteria used by stakeholders for assessing data quality requirements. To this end, we have put together an integrated

geographic database that over time will serve as a basis to design an innovative web portal to provide a data visualisation interface to the information provided for the local population *and* centres of expertise. This portal will be used in an interactive way by the communities as well as the local governments who can add, edit and download information. The centres of expertise will be provided with a decision-support visualisation that will allow direct integration into already existing applications for disaster monitoring.

Workpackage 4, *Transformations towards waterproofing data*, involves working together with the main stakeholder groups from the first three workpackages (centres of expertise, local government, and communities in São Paulo and Acre) to ensure the research conducted will have a transformative impact. While *Waterproofing Data* involves strong collaboration with stakeholders, and thus the conducting of the research itself is expected to deliver transformative impact, workpackage 4 was specifically designed to ensure the research is directly and thoughtfully incorporated into transformations of the data practices of key stakeholders, and that community knowledge of the research is accessible to all members of the community and beyond. To this end, over the course of the project, we hosted three workshops - one each at CEMADEN, São Paulo City Council and Acre Government – with the aim of transforming data practices. These workshops were carefully designed based upon the principles of appreciative inquiry that seeks to engage stakeholders in self-determined change. In order to channel these discussions into concrete proposals for transformation, each workshop was facilitated with the aid of user-centred design techniques (such as personas, storyboards, and user scenarios). The workshops were structured to present, first, ongoing findings (diagnostic phase); secondly, to facilitate creative thinking about current and future infrastructural practices (creative or dream phase); and thirdly, to advance ideas and principles that might be taken into practice situations (challenge or operational phase). At the end of each workshop, researchers in collaboration with stakeholders produced written recommendations for how best to achieve organisational transformation through improved data practices. While the written recommendations will be valuable for reporting to non-participants, we also consider participation in the workshops themselves as avenues for transformation. More concretely, in time, we will also produce and curate two exhibitions, with the aim of transforming

perceptions about the role of data in improving flood resilience within our study areas. These local exhibitions will equally draw from research data generated across the *Waterproofing Data* project to creatively inform citizens about the research findings of the project to raise awareness about flood risks and resilient behaviours.

Workpackage 5, *Translation of waterproof data into sustainable flood risk governance*, integrates the different work streams, interfaces with a broad range of policy and decision makers, and facilitates the interactions within and outside the project consortium by promoting impact workshops in Brazil, Germany, and the UK. These will facilitate a transcultural comparative dialogue involving the Brazilian and European researchers and stakeholders, as well as enabling the international comparison and generalization of lessons about sustainable flood risk governance from the project.

To this end, throughout the project we facilitated four policy and practice dialogue ‘impact’ workshops organised on user-centred design principles, which focused on awareness raising, mutual learning, policy foresight, networking, and transferability of results across different operational contexts. These events differed from a conventional research workshop in that the primary goal was to open up questions that are frequently unanswered and unanswerable and to generate open-minded dialogue amongst a range of different stakeholders. The key issues and considerations under discussion in the workshops were generated by the research team in advance (through our ongoing research). In each workshop, the search for answers and the process of raising multiple ideas was possible because of the collective expertise and specialisms of the delegates. Stakeholders were not treated as passive recipients of ‘research’, but brought into the idea generation process itself. Consequently, idea generation is not considered to be a ‘closed’ process, but as an open iterative and cumulative relationship where end users are encouraged to network and exchange knowledge and experiences, providing space for end-user considerations and needs. To facilitate this user-centred approach we adopted a World Café style format to provide an open and creative conversation on topics of mutual interest that surfaces collective knowledge, shares ideas and insights, and allows everyone to gain a deeper understanding of the opportunities and challenges of developing new practices in flood risk governance. In practical terms this meant ensuring that researchers and invited end-users

were not just passively 'placed together' at events, but that both were integral to event design and that an active and meaningful dialogue could take place that successfully accesses the collective wisdom in the room.

Reflections and outcomes of dialogic co-production of resilience

The *Waterproofing data* project is an example of community and research co-production in action and has illuminated a number of questions about how we can assess the success of co-production and, what possible tensions emerge as co-produced research is conducted.

Coproduction and transformative potential

The *Waterproofing data* project above all else is focused upon achieving transformations in sustainability and resilience in acknowledgement that existing ways of working are obdurate and not fit for purpose. This then places the emphasis upon governance and how decisions are made in processes of resilience building. New forms of governance increasingly require a shift from technical, functional bureaucratic and incremental ways of working. Contemporary governing assemblages require enhanced levels of co-production and engagement in decision-making with different networks of formal and informal institutions, people, and organisations. In this sense, governance can be seen in its wider meaning, to refer to the modes and practices of the mobilisation and organisation of collective action. Such collective action increasingly has a communitarian focus on the power that communities can exercise in order to negotiate, or in some cases resist, the imposition of certain policies and practices, and to achieve policy outcomes that suit their needs. Such approaches to governance emphasise the importance of advancing new policy discourses about place quality, improving collaboration among stakeholders in developing and delivering local policies, broadening stakeholder involvement beyond traditional elites whilst recognising different forms of local knowledge, and building rich social networks through which new initiatives can be transmitted (Healey, 1998).

However, from the perspective of embedding greater resilience, empirical studies show that despite the popularity of resilience, its implementation sometimes leads to business-as-usual approaches neglecting social justice, or lock-in of the development path through

unsustainable trajectories (Coaffee et al 2018). This implementation gap remains between resilience as an ambitious objective and the 'demonstrated capacity to govern resilience in practice' at the urban level (Wagenaar and Wilkinson, 2015; 1265). Whilst from a governance perspective we can readily acknowledge that the building of urban resilience will be most effective when it is co-produced, municipal authorities are undoubtedly struggling to do so. This shift from traditional risk governance approaches has proved challenging because resilience implementation in public administrations is, in most cases, in conflict with bureaucratic values such as efficiency and procedural rationality, which are difficult to balance with adaptability, redundancy, and innovation (Coaffee et al 2018). The problems identified above lie at the heart of the urban resilience implementation gap and complicate attempts to advance more adaptive governance models involving co-productive efforts and collaborative decision-making. This asks key questions about change and transformational potential and in particular, how 'mainstream' governance discourses and practices evolve from one mode of practice to another? How are new processes and practices effected by structuring dynamics and micro-politics? And, what does it take for new innovations to be translated into 'mainstream' practices, in ways which transform the mainstream rather than just incorporate new ideas and practices that neutralise threats to established practices and the various power relations embedded in them?

The results that emerged from the co-production approaches of the *Waterproofing Data* project offer initial encouragement that transformative change is possible in how flood resilience is viewed and operationalised, but these approaches are only a small first step in a much longer and complex process that will be decades in the making. What is evident is that through bringing different viewpoints, voices and data practices to the decision-making table, and in better understanding how local communities and official accounts perceive and act upon risk, we can observe a willingness to integrate these perspectives in pursuit of greater resilience. To this end we have advanced a framework for tracking transformation in governance that focuses on change over time with regard to: (a) networks and coalitions that identify stakeholders currently engaged in the delivery of policy area and evidence of community involvement collaboration and partnership (b) policy discourses reflecting how resilience is framed in official narratives and local accounts and (c) practices that identify

issues that affect the ability to deliver the policy area in an integrated fashion as well as identifying processes that are currently advancing a space for innovation.

Co-production and critical friendship

Co-produced research is an increasingly prominent feature of the contemporary world where researchers can occupy a privileged location at the interface between theory and practice. Not only can such relations bring knowledge production and increasingly grounded and policy relevant work but the synergies generated, can also 'open doors' into otherwise impenetrable worlds or can facilitate access to unreachable communities of policy or identity. In our work, not only has *Waterproofing Data* witnessed transformative potential in governance terms but also in some ways has facilitated it through the research process. Co-production, often through collaborative research efforts, can bring many privileges for the academic researcher. Beyond opening doors, co-production may keep doors propped open through the development of long-standing commitments (or even of friendships) or through more formal reciprocal agreements and arrangements.

Whilst we have little doubt, and can say from our own experience, that co-production presents many opportunities, it can be challenging. In any co-produced research process there are key tensions with respect to both its conceptual direction and its practical and ethical conduct that need to be addressed. Notably, there is an overarching risk that co-produced studies may be subjected to an almost inevitable 'pull' into external agendas, not least due to the significant degree of often sustained engagement that is entailed with co-producing partners. There is, too, a potential blurring of boundaries between the researcher and the researched, but this should not infer that it is impossible to resist excessive influence from external agencies. Although, for instance, there may be a considerable degree of direction provided for a co-produced project, research agendas need not be excessively rigid. A key role, then, in working collaboratively, or as 'critical friends', is the ability to negotiate clear positionality and independence as researchers.

Although the term co-production implies a degree of equality regarding the development of an overall research strategy, in practice this is a negotiated, and therefore fluid process involving research teams, sponsors and any advisory group that might be established. Therefore, a range of concerns and compromises that need to be carefully balanced

frequently underwrites any such study. Whilst undertaking co-produced research we should be aware of the comments of the academic planner, Bent Flyvbjerg, who warns us that the process of producing knowledge and the fate of projects in terms of desirable outcomes can be strongly influenced by the mechanics of power and rationality: "...power often ignores or designs knowledge at its convenience" (2001, 143). At the same time, all research data, we should remember, is not collected, but is generated through complicated researcher/subject interactions. Clearly, partners – or more appropriately, co-producers - often approach a project with certain motives, and may pursue pre-determined agendas. In many cases, as recent work has argued, the political and power dimensions of co-production serve to reinforce rather than mitigate existing unequal power relations and in so doing restrict governance transformation from taking place (Turnhout et al 2019).

With these challenges and tensions in mind, as co-production research becomes ever more sought after, we need a range of tools to support core values of research to negotiate the challenging relationships and circumstances in order to both gain and retain access to research events and subjects and to meet the requirements of funders and partners. The coping strategy that we adopted was as a promoter of mutual learning; in helping develop a better understanding among stakeholders of the multiple viewpoints surrounding a particular issue, and in supporting their needs where appropriate. This model of the 'critical friend', drawn from public policy literature (Rallis and Rossman, 2000), blurs the borders between the act of research and those being researched. Here, the traditional power relationship between researcher and the researched is made more equitable, with each recognising the contribution the other can make to the research process. This is complemented by our Freirean dialogical perspective, which acknowledges intrinsic asymmetry between the roles of scientists and citizens, and proposes to deal productively with this through openness and dialogue (de Albuquerque & de Almeida, 2019). Following Freire, it is only by being open to face the risk of Otherness that co-production processes will be able to promote dialogical modes of engagement that are truly empowering and capable of giving people a voice.

We would argue that developing 'critical friendship' with a dialogical mode of collaboration is a more engaged role than that of the evaluator-type research. In essence, the researcher

is not an external judge but tries to act with an independent voice, holding a mirror to those involved in subjects, and helping them reflect upon their own practice. The critical friend must also be a storyteller and present opinions for scrutiny. As Coaffee and Diamond (2008, p.95) noted: 'It is not only important to have the skills necessary to represent competing narratives, but also to identify themes and questions which challenge particular narratives'. Ideally, the negotiation of critical friend status should be held at the outset of research to help resolve (as far as possible) issues before the study gets underway, and to outline the expectation of co-producers at the outset.

The essential future of co-production research

Our recent experience of working with and co-producing knowledge alongside policy makers in the area of resilience has been rewarding, yet immensely challenging. For all partners it has been a steep learning curve, involving fundamental questioning of the different cultures of universities, local citizenship, and policy communities. Each co-producer has a preferred or traditional way of working with their associated timescales, the outputs that are required, and procedures that must be implemented to deal with data or sensitive information. As co-produced research becomes more the norm than the exception, these cultural impediments will lessen.

Equally, it has become clear to us that co-production is also a central factor in new modes of knowledge building and research, in reshaping local governance dynamics and transforming how context-specific decisions are made and implemented. Simply rolling out classical models of superficial community and external stakeholder consultation where local citizens or businesses become co-opted or 'responsibilised' to fulfil state-type roles is not sufficient. This then, places co-production as a necessary ingredient in research looking to transform conventional and institutionalised power relations in decision-making in order to secure the future through a better understanding of how we respond, in a flexible way, to all manner of risks and crisis. This helps explain how resilience has become central for how we govern uncertainty through engaging in dialogic co-production. As Galuszka (2018: 155) has noted in his studies of urban planning in the global south, 'it can be argued that co-productive governance provides a flexibility to change, adapt and update proposed solutions. In contrast to classic participatory spaces, this can mean that civil society actors are not merely consulted regarding specific decisions, but are active implementers of them too.'

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