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Co-designing Possible Flooding Solutions: Participatory Mapping Methods to Identify Flood Management Options from a UK Borders Case Study

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Abstract

his paper reports on the findings developed by a funded project within the UK Rural Economy and Land Use Programme: 'Managing borderlands: adaptive decision making amongst specialists and non-specialists'. The project focuses specifically on the development of a nested-scale participatory GIS (PGIS) method to identify spatially local perceptions and experiential knowledge of the risk and vulnerability of two catchments in the Scottish–English Borders. The method attempts to move beyond mapping risk towards the co-design of possible solutions. This will highlight the potential for improved inclusion of local perspectives on risk afforded by using PGIS mapping approaches in the UK context. The potential of the approach to generate co-designed community preferences leading to more resilient solutions (particularly in terms of social and economic consequences) to environmental change will also be discussed.

Keywords:

adaptive flood management; participatory planning; co-design solutions

1 Introduction

The arguments in favour of increased public participation in decision-making have been characterized by Chess & Purcell (1999) as being based on two theoretical frameworks. The first, termed 'theory-based', stems from the arguments that public participation increases fairness in society; the second, which is 'criteria based', encourages increased participation if it benefits decision-making agencies. These two theoretical framings overlap in relation to risks and risk management. In the words of Stern & Fineberg (1996): 'Although risk characterizations are often made for the benefit only of an organization's decision maker, it is important to recognize that various other parties use them when they exercise their rights to participate in decisions either before or after the organization acts.' The need for public participation in risk characterizations was justified on the basis that failing to take into account multiple voices, including those of citizens, would result in the assessments and outcomes of official processes being criticized as incompetent and therefore irrelevant. 'The common practice of eliciting comments only after most of the work of reaching a decision has been done is cause for resentment of risk decisions. [...] Many decisions can be better informed and their information base can be more credible if the interested and affected parties are appropriately and effectively involved' (ibid).

The recent proliferation of spatial participation approaches in mobile computing (Stevens & Maisonneuve, 2009; Willis et al., 2009), web-mapping (Kingston et al., 2000; Kyem & Saku, 2009); mass data from volunteered geographic information (Goodchild, 2007, 2011; Mooney & Corcoran, 2011); crowdsourcing information (Brabham, 2009; Hsueh & Melville, 2009); Citizen Science (Gura, 2013; Silvertown, 2009); community involvement in planning (Department for Communities and Local Government, 2011; John, 2012; Yuille, 2011; Catney et al., 2013) reflect these on-going drivers for participation (White, 1996). This use of spatially-based approaches in the deliberation around risk management choices related to environmental change has particular justification, for example involving local people in the debate, and drawing on local knowledge, in the precise locations where the impact of environmental change is being felt (Cornwall, 2002).

Qualitative GIS (Cope & Elwood, 2009) is posited as one response to the critiques of GIS emanating from the science and society debates of the 1990s (Pickles, 2006). It aims to differentiate itself from previous qualitative uses of mapping software (such as data storage or visualization) in terms of assessing the way meaning in spatial data production and analysis is generated at different stages in the GIS process. Qualitative GIS promotes hybrid epistemologies and mixed data-collection methods and analysis in order to develop more robust explanations of processes and practices. The integration of a relevant mixture of qualitative and (semi-)quantitative approaches (in GIS, Community Mapping and PGIS) addresses this need for 'methodological experimentation and reflexive attention to the consequences of these interventions that allow us to engage critically with the political possibilities offered by this articulation between technologies, publics and participatory practice' (Davies & Dwyer, 2007). It has similarities to other mixed-method approaches that use a variety of social science analytical tools systematically to integrate the 'qualitative' and the 'quantitative' in order to better understand phenomena (Shaffer, 2013).

Underpinning these approaches is unpicking what is meant by qualitative and quantitative methods. Marianna Pavlovskya (2006) represents GIS methods as a continuum between quantitative and qualitative approaches, with no clear boundary or disconnect between the two. She highlights how many of the functions of GIS make it suitable for qualitative data investigation and analysis, particularly in visualizing qualitative information in a spatial context (Pavlovskaya, 2009). Cope and Elwood represent data as qualitative if it includes assessments of contexts, processes and meaning – information that allows us to understand situated or negotiated knowledge. This would often include data that would usually be considered quantitative but that is included in an analysis due to the cultural norms of the institution undertaking the assessment. In the context of GIS, a qualitative framing sees it as a mixture of technology, methods and institutional or social practice (Cope & Elwood, 2009).

As the winter of 2015/16 demonstrated vividly, the increasing severity and frequency of flooding in UK catchments is a major issue for planners in terms of building resilient solutions, particularly in relation to the potential impacts of on-going climate change. Historically, flood and catchment management options have been developed with only limited reference to the experiential knowledge, expertise and preferences of local people. In this context, the inclusion of local 'lay' views is important (sic. Aarhus and the Water Framework Directive), both from a theoretical standpoint (fairness of decision making) and for justifying the criteria used (pragmatic effectiveness of decision making). However, current mechanisms for this to happen, and in particular to feed robust information 'up' from the local to the strategic decision-making level, frequently lack transparency.

2 Methods

The project used two, predominantly rural, sub-catchments of the River Tweed as cases, one on each side of the border between Scotland and England (specifically Peebles/Eddleston and Wooler) (see Figure 1). The region faces significant future flood risk. It was affected by severe flooding in December 2015/January 2016, having already experienced severe flooding just a few years earlier (2008 and 2009); it is also projected to experience more frequent and severe events due to climate change. The Tweed catchment requires a unified River Basin Management Plan reflecting its socio-spatial position as a politico-cultural-geographic borderland, as well as its position at the boundary between scientific and non-scientific stakeholder understandings.

To generate community-identified solutions for flood management, a nested methodology was employed utilizing different participatory GIS methods and interacting with various and changing stakeholders, depending on the stage of the process.

Stage one of this process to co-design a solution for the problem of flooding concentrated on scoping. This involved working with small groups of informed individuals or those empowered to represent a particular stakeholder constituency (e.g. farmers, local flood wardens). A focus group-based PGIS methodology (Cinderby et al., 2008) was employed with these small groups of participants. They were asked to comment on where floods had occurred and to give their thoughts on causes, thus drawing on their own experience and knowledge in relation to the problem. We then asked participants to indicate where they felt optimal flood protection or land use changes might address flooding or flood impacts; throughout, we listened to their commentaries and rationales. This process of mapping experiences followed by reflections on approaches to reduce risks and exposure to flooding represented the co-design of potential solutions. The process (and the interaction between risk assessment and solution co-design) is presented in Figure 2.

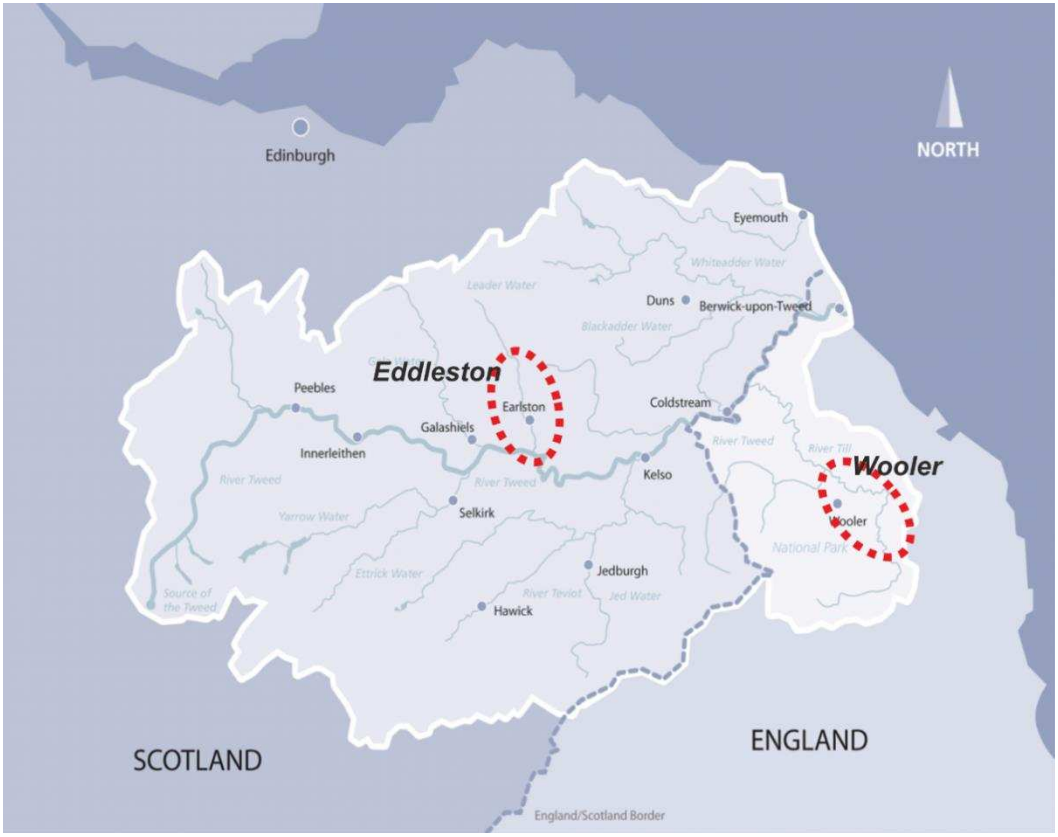

Figure 1: Case study locations in the Tweed catchment

Methodologically, this community mapping approach involved generating base maps of aerial photography overlaid with relevant cartographic data of contours and place names (printed at A0 size, 84 cm by 119 cm) for each community, one of the whole sub-catchment, and the other in more detail for the urban area. This combination of colour imagery with cartographic references was particularly useful in the solution-generation process as it facilitated orientation and identification of key locations and current land covers.

Participatory mapping used plastic acetates, with different layers to record specific themes or information. We noted where participants made responses on the maps, and we linked these mapped references to their comments on audio recordings of the group discussion. This low-tech approach was used to encourage participation with minimal technical barriers. The mapping exercise itself took approximately two hours, which included introductions and refreshments.

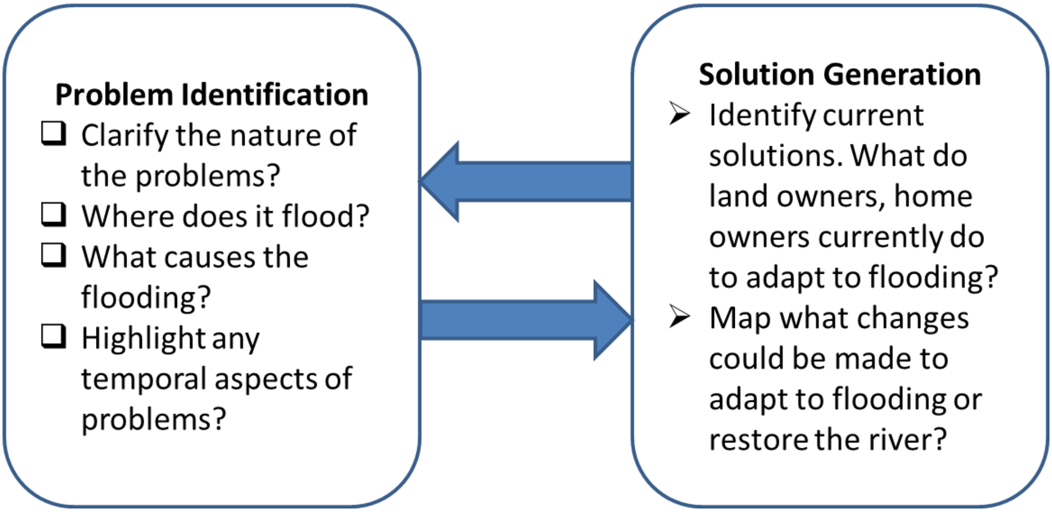

Figure 2: Participatory GIS co-design process linking risk assessment and co-designing solutions

The results from the scoping meetings were assessed; using on-screen digitizing, they were converted into ESRI ArcMap shapefiles for the two catchments, to produce cartographic visualizations of the co-designed flood solution options.

In order to validate these options with a wider constituency than the necessarily limited participants from the scoping meetings, maps of the solution designs were produced and taken to agricultural shows. A different PGIS method, Rapid Appraisal Participatory-GIS (Cinderby, 2010), was employed. This method encourages swift engagement and is suitable for capturing the views and opinions of a large number of people. It was particularly suitable for engaging people at an event where participation in our survey was not the primary (or even secondary) reason for their attendance.

Participants were asked to identify which solutions they agreed with and which they would prioritize in the short and longer term to address flooding. If they had alternative solution suggestions that had not been identified in the first iteration of co-design, these were also recorded. The results of this interaction were digitized and represented as graphs alongside the maps.

Results

The scoping activities identified detailed, spatially-specific experiential knowledge of local risk levels in relation to flooding exposure. The co-design process which followed developed a mixture of conventional (hard-engineered) measures for precise locations, and some novel, adaptive, flood-management proposals that had not previously been identified through official processes. These adaptive measures included riverine and wetland habitat restoration, engineering log jams to slow river flow, and building leaky ponds to store water in peak water flow events. Some of the options identified, such as calls to slow water upstream, could be achieved either through adaptive means or through conventional engineering. These were therefore classed as fuzzy solutions.

The validation phase identified considerable support from a wider constituency for these novel, adaptive, flood-management solutions. In total, we spoke with and captured the preferences of 114 people across two events. This highlights the efficacy of the engagement method and the success (in terms of resonance with a wider audience) of the co-design process. The preferences of the wider group can be seen in Figure 3.

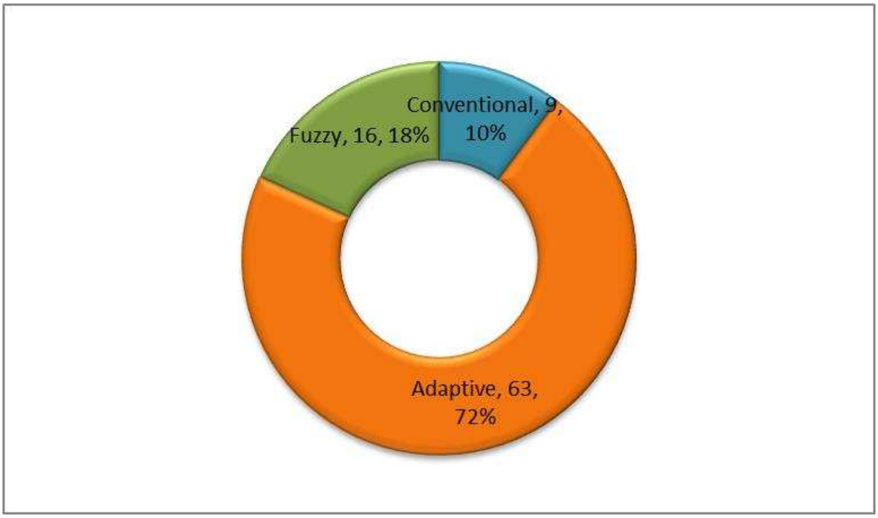

Figure 3: Preferences for adaptive vs conventional flooding solutions from the validation exercise

Conclusions

The use of the nested-scale (in terms of levels of participation), participatory- GIS methods proved effective in identifying local understanding of risk exposure across a catchment. The endorsement of these views at the validation stage perhaps indicates a shared experience of the flooding event itself, leading to a similar understanding of potential solutions. The use of mixed spatial methods demonstrated that local participation in decision-making around environmental risk management and mitigation could be successfully developed as an effective and efficient planning tool.

Note: The introduction to this paper contains material previously presented as part of Steve Cinderby's PhD thesis. A section of the thesis relevant to the topic of risk and PGIS has been utilized here.

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