Towards two-way flood risk communication: current practice in a community in the UK

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ABSTRACT

Despite the considerable progress in engineering works, flooding continues and is now recognized as a major and increasing challenge. This realisation has resulted in a shift in flood risk management from leaning heavily on structural measures to the incorporation of non-structural initiatives, such as communication about flood risks that is considerate of the diversity existing within communities and that encompasses the entire disaster cycle. Communities that are more aware of flood risks and possess the knowledge to prepare for disasters appear to be better able to respond, mitigate and recover from their detrimental impacts. This paper examines the current practice of flood risk communication strategies of a local community in Doncaster, UK. The research findings are analysed with a view to identifying factors that positively and negatively influence the flood risk communication strategies and community resilience. Based on these insights, we provide recommendations for further improving the communication about flood risks, and ways in which it could be better targeted and used throughout the disaster cycle to help strengthen community resilience.

Key words | community resilience, disaster cycle, disaster risk management

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INTRODUCTION

Major flooding events have impacted Europe during the last decade, including floods in the Elbe and Danube (Rojas *et al.* 2013) and most recently in the Balkan region, Germany and the UK. In the UK, there has been 'unprecedented' flooding in 2014 and 2015 despite a 2.3 billion pound investment in the country's flood defences during the period 2011–2015 (Bennett & Hartwell-Naguib 2014). In 2015, thousands of homes in northern England and Scotland were hit by severe flooding after Storm Desmond, Storm Eva and Storm Frank. Despite the progress of engineering works in flood disaster reduction over the last twenty years, flooding continues to be a major challenge (Yamada *et al.* 2010; Sayers *et al.* 2014). There is a growing recognition that flood risk management

should be integrative and adaptive using a portfolio of structural and non-structural responses (e.g. Hall *et al.* 2003; Bruijn 2004; Ashley & Brown 2009). Non-structural responses consist of improved land-use planning, relocation, insurance, flood proofing, flood forecasting and warning (Bradford *et al.* 2012). In several European countries, integrated flood risk management considers the full disaster cycle in the management and prevention of flood disasters (EEA 2010). The challenge is now to mainstream these approaches into common flood management practice.

Emphasis on strengthening flood warning and the communication of flood risks to flood-prone households and businesses have been one of the main items of England's Environment Agency's National Assessment of Flood Risk (EA 2009). Some of the planned strategies or actions were improvements in the accuracy, coverage and timeliness of the UK's flood warning system as well as the use of flood

maps by property owners and local authorities to show where floods may occur and how severe they are likely to be. It is essential that local authorities and communities understand the factors behind the increasing flooding risks such as extreme weather and climate change issues, in order to stimulate community action to increase resilience (Twigger-Ross et al. 2014). The effectiveness of flood risk communication strategies is dependent on many factors such as public perception. The public is heterogeneous in nature, with differing cultural norms, language mastery, household structures and role obligations (Höppner et al. 2010). The public perceives and evaluates information differently based on their personal experiences of the institutions that are providing that information, alongside other sources of knowledge (Fielding et al. 2007). Hence, flood risk communication strategies need to take this diversity into account, in order for communication to have a bearing on community disaster preparedness. Although there has been an evident shift towards improving flood risk communication strategies as a result of the lessons learned from previous flood occurrences, there are still questions regarding the implementation of the adopted strategies (Wehn & Evers 2015).

The aims of this paper is to analyze the current practice of flood risk communication strategies, based on empirical research in a local community in the UK (Toll Bar village, located in Doncaster, South Yorkshire). The UK flood in the summer of 2007 was a critical juncture that lead to fundamental changes in the way the country manages flooding risks since, such as the shift of responsibilities to the local level (Twigger-Ross et al. 2014) and the need to raise public awareness and preparedness for flooding (Pitt 2008). This paper aims to identify the positive and negative influences on the flood risk communication strategies.

POLICY AND THEORETICAL CONTEXT

Policy developments in flood risk management

Towards the end of the 20th and early in the 21st century, flood risk management focused primarily on the implementation of structural engineering solutions, including in the UK, whereby its flood management policy has traditionally favoured large-scale engineering responses, such as flood embankments and channelisation (Brown & Damery 2002; Ashley & Brown 2009). In the recent past, however, major flood disasters have acted as catalysts for changing flood risk management policies: there has been a shift towards management of the whole flooding system in an integrated and adaptive way, recognising associated (deep) uncertainties and taking into account all of the potential interventions that may alter flood risks (e.g. Sayers et al. 2002; White 2008; Newman et al. 2011; Dawson et al. 2011; Huntjens et al. 2011; Pahl-Wostl et al. 2012; Zevenbergen et al. 2013). At the heart of this new approach is resilience: striving towards an appropriate balance between protection, prevention and preparedness, both now and into the future (Zevenbergen et al. 2008; Gersonius et al. 2010). This is in line with the EU Flood Directive in which flood risk management plans should focus on prevention, protection and preparedness (EC 2007). Consequently, the importance of the role of community partnerships and the need to raise awareness and preparation within communities, were recognised in the management of flood risks (DEFRA 2005). For example, in the UK Department for Environment, Food and Rural Affairs, the 20-year government strategy Making Space for Water presented a wide range of mitigation measures to include the conceptualisation of flood risk and flood risk communication (McCarthy 2007). As a result, there has also been a growing trend towards the inclusion and consideration of citizens and their voices, such as the establishment of public participation mechanisms outlined in the European Flood Directive 2007/60/EC, ensuring that the public not only has access to information relating to flood risk assessment and management, but also has a say in the planning process (EC 2014). Simultaneously, the UK government has been transferring more powers to neighbourhoods whilst encouraging communities to play a more active part in society, shaping the places in which they live (Cabinet Office 2010). Thus, the general trend appears to assume that citizens are capable of addressing their local issues and recognises the need to capitalise on the skills and expertise of its people.

The role of resilience in flood risk management

Resilient communities are able to absorb the shocks of the hazard impact, demonstrate the capacity to bounce back

during and after the disaster and, finally, take the opportunity to change and adapt following a disaster (ADPC 2006). Communities that are resilient have improved capacity throughout the disaster risk management cycle due to awareness and knowledge of the risk (Schelfaut *et al.* 2011) and experience fewer disaster impacts and a lower degree of fluctuation as compared to less resilient communities (Mayunga 2007). Without an explicit operational definition, resilience has only a broad meaning, and remains a vague concept rather than a practical policy or management tool (Bahadur *et al.* 2010; Fekete *et al.* 2014). Although disputed, metrics and indicators are typically used to evaluate the resilience of communities, to provide baselines for comparison and the foundation for a system of tracking improvements (Cutter *et al.* 2010). In broad terms, most of the frameworks to measure community resilience focus on factors that include economic resources, assets and skills, information and knowledge, support and supportive networks, access to services, and shared community values (Mayunga 2007). O'Sullivan *et al.* (2012) assumes that individuals who engage with and respond to flood communications have higher resilience levels, resulting from knowledge gained through communication of flood information and warnings.

Risk communication

Risk communication is broadly defined as 'a social process of information exchange between any entities in society on any form of risk (individual, social, political, environmental) that is purposeful or non-purposeful' (Höppner *et al.* 2010, p. 7). Initial communication efforts in the 1970s were directed at changing people's views on risk, particularly in the acceptance of technology, while later risk communication attempted to increase public trust in regulatory institutions (Frewer 2004). Specifically in terms of floods, risk communication includes all communication between various actors at multiple scales, which then allows for risk assessment and taking the appropriate measures (Schelfaut *et al.* 2011). In recent times, risk communication has slowly evolved into a two-way communication process (Kellens *et al.* 2013) and is re-orienting towards a citizen focus, shifting away from top-down communication practices (Frewer 2004), not least because of the possibility

provided by information and communication technologies (ICTs) (Wehn *et al.* 2015a).

In reality, a breakdown in the communication channels remains a significant factor in the inadequate or failed responses of past natural disasters (O'Sullivan *et al.* 2012). It is therefore pertinent that there is effective communication, especially when communication transcends and links the four phases of the disaster risk management cycle (Höppner *et al.* 2010). In order for risk communication to be effective, O'Neill (2004) argues that specific risk communication messages are required for the different stages of the disaster and that the public is more likely to take appropriate and effective steps to reduce and mitigate risks if there is focused communication of flood risks (Yamada *et al.* 2010). Alexander (2008) highlights the need to consider the social, perceptual and cultural aspects in the warning process to the local beneficiaries. Four out of six recommendations in the Environment Agency's Public Response to Flood Warning revolved around tailoring information and understanding that flood warnings need to be more area-specific and attuned to the local needs of the intended at-risk groups (Fielding *et al.* 2007).

Risk communication is an important component of disaster risk management as it conditions people's perceptions of risk and consequently impacts their actions and intervention decisions throughout the disaster management cycle (ADRC 2005; Alexander 2008). The effects of risk communication interventions during the four stages of the disaster cycle are the subject of this study, as illustrated in Figure 1.

Figure 1 │ Risk communication as an important component of disaster management throughout the disaster management cycle.

METHODS

Study area

Doncaster, and the Toll Bar village in particular, was selected as the location for our case study, based on its vulnerability to floods, coupled with the presence of community-driven networks, particularly the flood warden scheme.

Doncaster is a town located in South Yorkshire metropolitan county, in the region of Yorkshire and the Humber of England. Together with its surrounding suburbs and settlements, this town forms part of the Metropolitan Borough of Doncaster, where the Doncaster Metropolitan Borough Council acts as the local authority. Forty to fifty percent of the South Yorkshire area is located within the floodplain and with an estimated 5,000 (EA 2009) to 25,000 properties (Wehn & Evers 2015; Wehn et al. 2015b) facing a significant likelihood of flooding. Doncaster is vulnerable to fluvial, pluvial and tidal floods, due to its low-lying topography and worsened by the increasing level of urbanisation and repercussions of climate change. Hence, the area relies heavily on artificial drainage systems to manage surface runoff (DMBC 2011). This area has a long history of floods, the first recorded event occurring in 1536 when the river Don flooded. The Don River and its tributaries in the West pose the greatest risk to central Doncaster while the Trent River in the East may cause significant surface water or tidal floods in some areas (DMBC 2010). Doncaster was one of the more severely hit areas in the summer flood of 2007, whereby the total damage was estimated between £13.5 to £14 million (Doncaster Free Press 2008). The flood was a result of a combination of extreme levels of rainfall compressed into short periods of time and was considered to be the most expensive in the world in 2007 (Pitt 2008). According to the Schuhle-Lewis (2008), the Toll Bar area received 'heavy relentless rain that had not been seen for years' (p. 20). According to the UK Meteorological Office, much of Wales, the Midlands, Northern England, Northern Ireland and parts of Scotland and South-west England received more than 150 mm of rain, with over 250 mm locally (Met Office 2007). This is over three times the average June rainfall over much of the West Midlands, Lincolnshire, Yorkshire and the Humber.

The establishment of a flood warden scheme in Doncaster is a reflection of the aspiration of residents to mitigate the detrimental flood impacts, in close partnership with England's Environment Agency and other key local partner organisations (McDonagh 2011). In the Toll Bar village, a citizen observatory is currently being implemented, tested and validated (WeSenseIt 2015). The observatory enables citizen involvement in collecting data using a combination of sensors and monitoring technologies as well as capitalizing on the citizens' collective intelligence (Wehn & Evers 2015). One of the components of the observatory is the engagement of flood wardens as 'human sensors', tasked with the responsibility to capture and report their observations of the surroundings, e.g. via photographs.

Data collection

Information was collected from primary and secondary sources. Primary data sources include information obtained through interviews and observation during fieldwork. Desk research seeking information from various reports, documents and other publications was considered as secondary data sources such as flood leaflets by the Environment Agency and newspaper archives of the 2007 flood. Open-ended questions and a set of 18 ranked questions with five response options (strongly agree, agree, uncertain, disagree, strongly disagree, plus not applicable/no opinion; see also Ngo Thu & Wehn 2016) provided the data for a quantitative and qualitative analysis. These questions were posed in a series of semi-structured interviews that were held with flood-affected community members in Toll Bar (further categorised into villagers and flood wardens), government staff of the Doncaster Metropolitan Borough Council (Doncaster MBC) and a staff member of the National Flood Forum (NFF), a non-governmental organisation (NGO) which works with communities in England and Wales.

Sampling strategy

The empirical research was carried out in January 2014 whereby 16 stakeholders were interviewed, five of whom

provided in-depth information based on the open-ended questions. This sample size is similar to other research efforts in this case study area (e.g. Wehn & Evers 2015; Wehn et al. 2015). Flood-affected villagers and flood wardens were interviewed to gain first-hand accounts of their flood experiences. Established after the flood in 2007, flood wardens are volunteers who support the Environment Agency and the Doncaster MBC by ensuring that flood warning messages reach the local community and that they are acted upon. The distinction between villagers and flood wardens was relevant in order to be able to identify possible differences in their responses. The interviewed government officials gave insights into how the authorities dealt with the impacts of the 2007 flood and the developments thereafter, in Doncaster and specifically in the Toll Bar area. The NFF was consulted in an effort to gain a more complete understanding of the assistance provided, beyond those channelled through the government and the support system within the village. A summary of the quantitative and qualitative data collection among these stakeholders is presented in Table 1.

Data analysis

The qualitative data collected in response to the open-ended questions was transcribed, the names of the interviewees coded, and the responses of the interviewees collated for each of the questions. The quantitative data from the ranked questions was entered and analysed in Excel. The primary and secondary data was analysed to identify, first, the current practice in flood risk communication in the UK, and in Doncaster in particular; second, the risk communication interventions in Doncaster during the four stages of the disaster management cycle as well as positive

Table 1 | Overview of stakeholders in data collection

Type of stakeholders	Open-ended questions	Ranked questions
Government officials	2	2
Villagers	–	8
Flood wardens	2	5
NGO staff member	1	1
Total	**5**	**16**

and negative influences on the flood risk communication strategies.
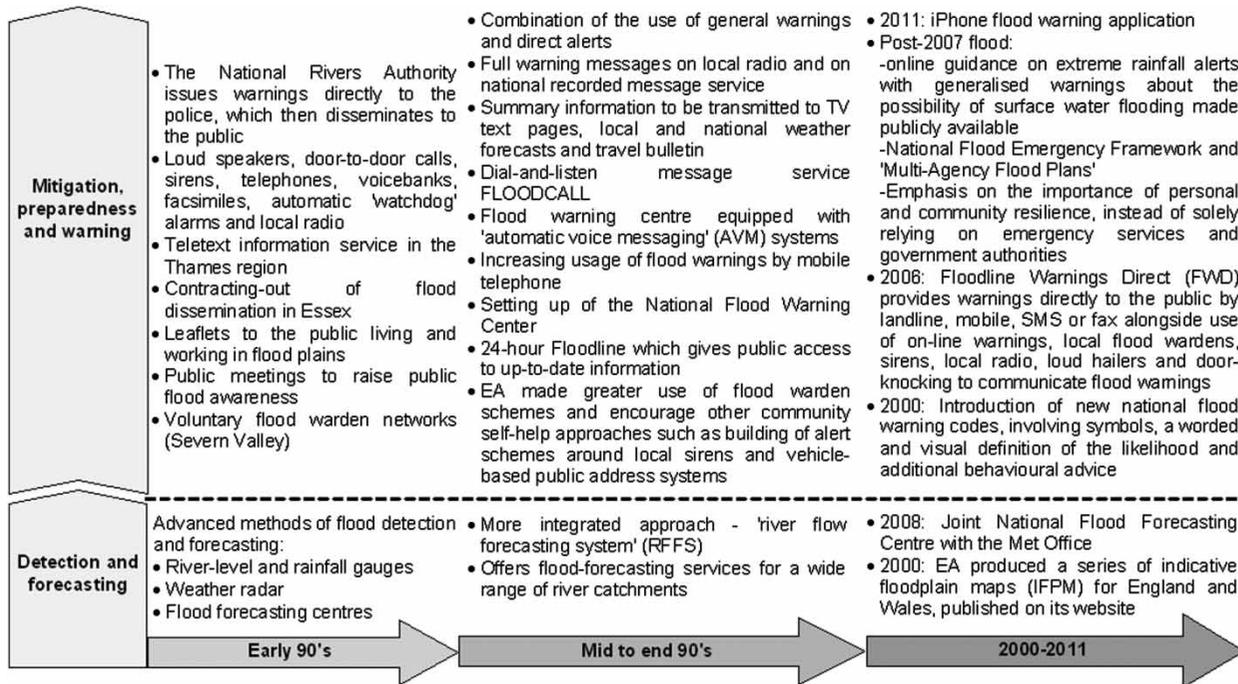
RESULTS AND DISCUSSION

Progression of the flood risk communication strategies in the UK

Our review of the UK's flood risk communication strategies over the last three decades indicates a progression towards the communication of risk and awareness (see Figure 2). Although the overview of these strategies is by no means exhaustive, it does serve to illustrate the overall evolution of flood risk communication in the UK. Multiple risk communication strategies and more specific information tailored to the needs of the communities at-risk seem to have been gaining prominence. The information disseminated through some of the more advanced communication strategies appear to be increasingly real-time and interactive in nature. There has been a rapid development of ICTs, which enables communities to provide valuable feedback about their local situation, instead of being only at the receiving end of the communication chain. For example, the recent proliferation of mobile phones and the availability of internet facilities at the household level have enabled users to receive flood warnings and flood-related information via multiple channels at a greater speed and reach.

The evolution of the flood risk communication strategies has been and still is significantly influenced by government recommendations, in response to lessons learned from previous floods (e.g. Fielding et al. 2007; Pitt 2008; EA 2009). Generally, the recommendations focused on recognising the existing diversity within the communities, with the aim of increasing their understanding of flood risks and ensuring that the information conveyed is sufficiently specific to be able to prompt actions or responses. The Pitt report (Pitt 2008) was one of the most comprehensive reviews undertaken as a result of the 2007 summer flood. It has significantly steered the direction of flood risk communication strategies in the UK such as the push for partnership between the Meteorological Office and the Environment Agency and better utilisation of local knowledge through formalised structures such as the community flood warden groups (Pitt 2008).

Figure 2 | Overview of the progression of flood risk communication strategies in the UK. *Source:* Compiled from Parker *et al.* (1995), Haggett (1998), Handmer (2001), McCarthy (2007) and Parker & Priest (2012).

Flood risk communication strategies in Doncaster

In general, the management of flood risks in the UK is dealt with via devolved administrations. In the case of Doncaster, it is governed by a number of key agencies due to its geographical and administrative boundaries. Although most of the interviewees perceived improved clarity with regards to the responsibilities of the different water-related agencies following the 2007 flood, there seems to remain some level of confusion amongst the Toll Bar villagers on who is doing what, where and when. In Toll Bar, communication of flood warnings is carried out formally and informally. Formal communication (mostly one-way) is led by government authorities such as the (national) Environment Agency and the local authority (Doncaster MBC) and primarily carried out via official channels such as the phone-based flood warning services known as Floodline Warnings Direct (FWD), Floodline and the quickdial numbers. The FWD disseminates flood warnings to registered users via telephone, mobile, e-mail or text message while Floodline provides updated flood information via a 24-hour telephone helpline (EA 2009). Quickdial numbers enable villagers to connect to so-called Incident Rooms to

obtain area-specific information. Informally, communication of a more interactive (two-way) nature, is carried out between the flood wardens and villagers. Flood risk communication is contingent on linking 'local' knowledge with 'expert' opinions, which is reflected by the flood warden scheme that outlines the cooperation between the flood wardens and the authorities. It is an illustration of how knowledge on local water geographies can be critical for making expert knowledge 'workable' as suggested by McEwen & Jones (2010).

A schematisation of the different flood risk communication strategies (one-way and two-way flood risk communications) currently practiced in Doncaster and Toll Bar is presented in Figure 3, specifically focusing on the dissemination of flood warnings during the response phase. The communication strategies are represented by different icons and the nature of interaction is differentiated by the thickness and direction of the arrows. The uni- and bi-directional arrows represent one-way and two-way interaction, respectively. The degrees of interaction (low or high) are influenced by the frequency, the level of accessibility or proximity of these individuals to one another and the closeness of the relationship prior to the occurrence of a
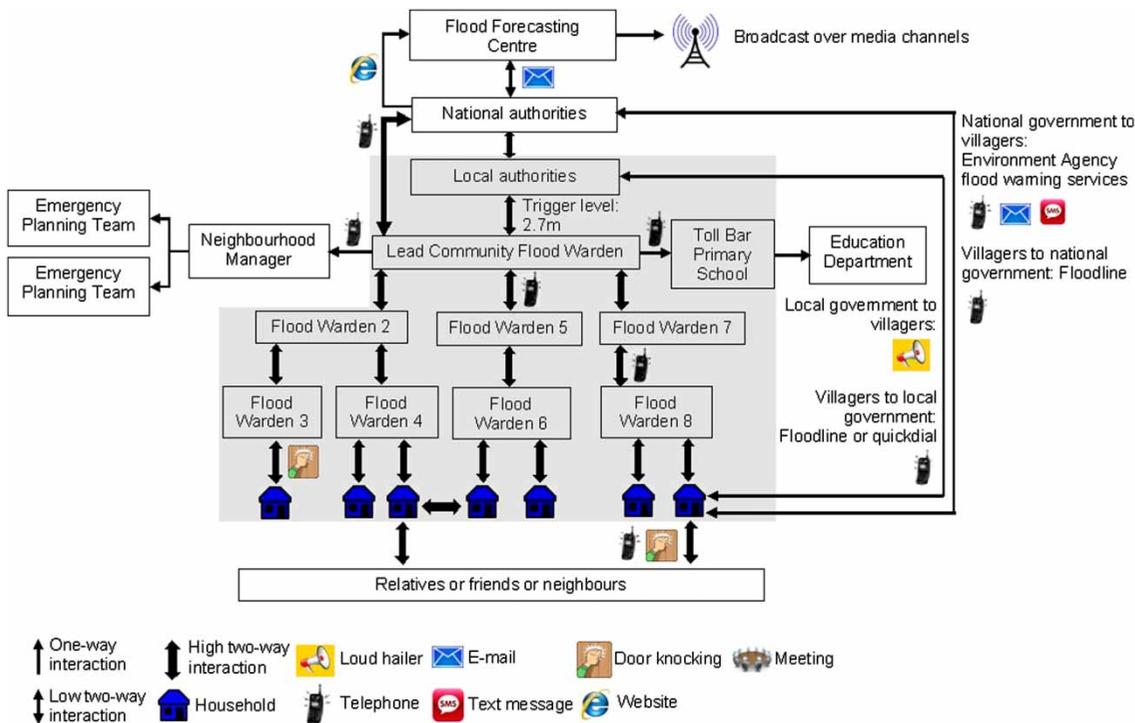
Figure 3 | Schematisation of the current flood risk communication strategies and the nature of interactions amongst the stakeholders in Doncaster and Toll Bar.

flood. The shaded area (see Figure 3) reflects the communication of flood-related information during the mitigation and preparedness phases (pre-disaster stage), where information is exchanged amongst the stakeholders to reduce the overall flood risks and/or to improve the level of flood preparedness. These communication strategies continue to be present and utilised during the flood warning phase. In Toll Bar, there seems to be a relatively high degree of two-way interaction amongst the stakeholders during this phase, particularly amongst the wardens and between the wardens and the villagers or key government officials.

One-way flood risk communication: characteristics of the flood risk messages

Diverse evaluations were obtained from the respondents on the characteristics of the flood risk messages (see Figure 4). In general, the flood wardens evaluated the characteristics of the flood risk messages more positively than the Toll Bar villagers. The negative evaluation by the villagers appears to be due to their rather unfavourable experiences

during the 2007 flood, mainly in relation to the performance of the Environment Agency flood warning services.

Two-way flood risk communication: interaction and incorporation of local communities' feedback

Diverse responses were obtained from the respondents in relation to the current level of interaction between the local communities and government authorities, except for the flood wardens, all of whom had evaluated the interactions positively (Figure 5(a)). The reason for this disparity could be due to the fact that flood wardens are much better positioned in the village to interchange information with the relevant government authorities. Having said that, the general evaluation indicates that flood risk communication strategies have been moving towards two-way interaction since the 2007 flood (see Figure 5(b)).

Most of the respondents confirmed the incorporation of local communities' feedback into the planning process by the government authorities (see Figure 6). Most of the interviewed villagers felt that their opinions have been more

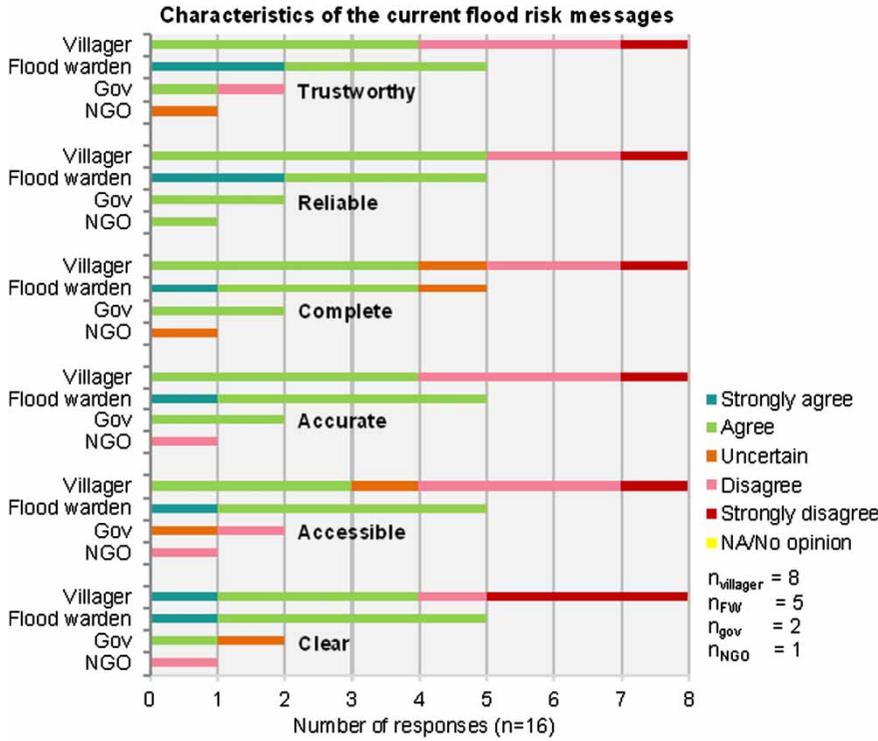**Figure 4** │ Respondents' evaluations to the current characteristics of the flood risk messages.
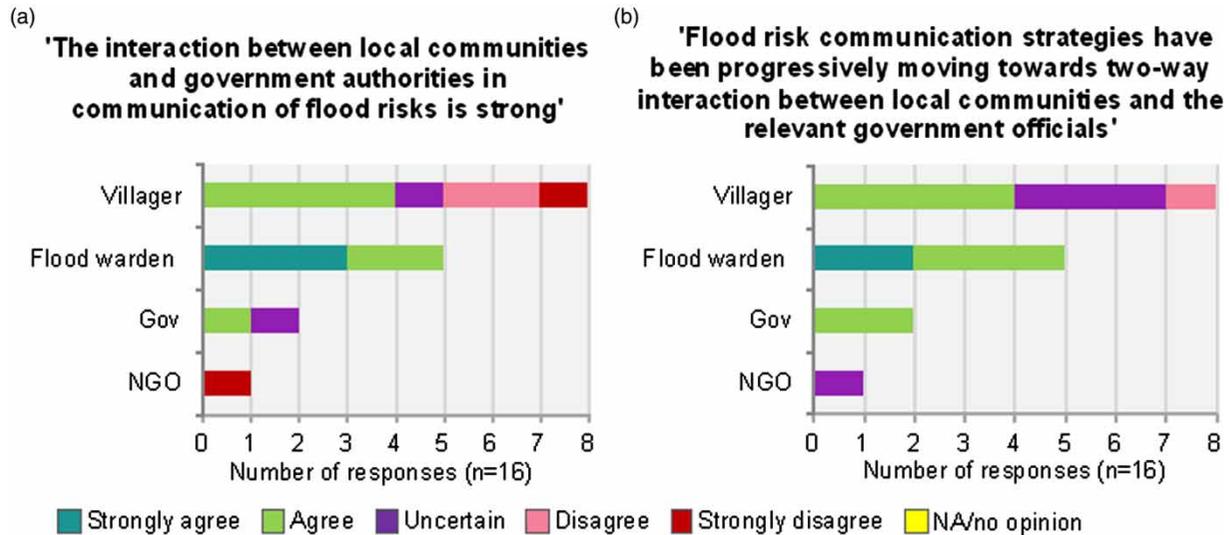

Figure 5 │ Respondents' evaluations to the current level of interaction and the progression of interactions between villagers and the relevant government officials.

actively solicited and their feedback taken into consideration by the representatives of the Doncaster MBC and the Environment Agency, especially after the 2007 flood. Some of the development works along the Ea Beck River

and the establishment of the flood warden scheme in Toll Bar were thought to have resulted from the collective action of and feedback from the villagers. This appears to be in line with the findings of Wehn & Evers (2015),
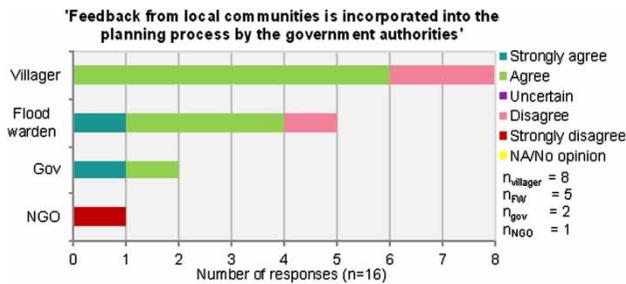
Figure 6 | Respondents' evaluations of the level of incorporation of local communities' feedback by the government authorities.

indicating that there has been a shift in the sequence of the project cycle of the Doncaster MBC and the Environment Agency from 'design-defend-implement' to 'discuss-design-implement'.

Emphasis on the role that the public plays in coping effectively with emergencies through practical measures, instead of solely relying on government authorities, came into focus after the 2007 flood (Pitt 2008). Recent initiatives of the Doncaster MBC providing channels for the public to be more actively involved in the planning process and to give feedback or to lodge complaints, are reflective of the effort to shift the mindset of community members from being 'customers' to taking up individual responsibilities in mitigating flood risks in the area in which they live. ICTs are playing an increasing role in this. Members of the public can register their complaints through submitting an online form via the official Doncaster MBC website or reporting it by phone to the round-the-clock Customer Service whereby response at the local level will be executed, or if need be, a more coordinated response at the national level. Another recent ICT-driven development has been the MyDoncaster phone application that allows the public to report issues to the Doncaster MBC by uploading a photograph, video or any other contextual information relating to civic issues such as blocked drainage or incidents of surface water flooding. According to one of the Doncaster MBC interviewees, more residents have signed up for the flood warning service due to improvement in the quality of weather and flood forecasts since the previous flood. Nevertheless, the authorities continue to face the complexity and the pressing need to strike a balance between warning the villagers in time and avoiding repetitive (false) warnings. Finding this balance will be imperative to regain the confidence of the Toll Bar community members

and to alleviate any residual negativity towards the performance of the local authorities on how the 2007 flood was handled. However, according to McDonagh (2011), the resistance and fear of the public as a result of that flood had somewhat been alleviated through the commitment of the Doncaster MBC to listen and to avoid exaggerated promises to the residents on what could be achieved.

The DMBC interviewee highlighted that one of their recent initiatives regarding the management of flood risks is the drafting of the local Flood Risk Management Strategy. One of the objectives of the strategy is to improve co-operation between the Doncaster MBC (as the Lead Local Flood Authority (LLFA)) with other Risk Management Authorities (RMAs) in order to meet the requirements of the Flood and Water Management Act 2010 (UK Government 2010). Since the introduction of the FWMA, the Doncaster MBC has strengthened working relationships with the relevant water authorities such as the Environment Agency and internal drainage boards. The strategy also strives to increase awareness of the Doncaster residents and other relevant stakeholders on their local flood risks as well as highlighting the works carried out by key government authorities. Some of the measures for implementing this strategy include distributing information related to the responsibilities of the LLFA and RMAs, advocating self-resilience through property level protection and improving clarity of key messages to the public. In principle, therefore, this strategy seems to combine several aspects of current 'best practice' for flood risk communication but its implementation still remains to be done.

Risk communication interventions during the four stages of the disaster management cycle

Some of the flood-related activities carried out and information communicated by the various stakeholders are grouped according to the different phases of the disaster cycle (see Figures 7 and 8). The actual activities appear to be a combination of initiatives driven by community members, such as the observation of environmental cues and the establishment of the flood warden scheme, and activities spear-headed by the (local) authorities, especially the construction of large-scale flood defences and the provision of emergency assistance during a flood.
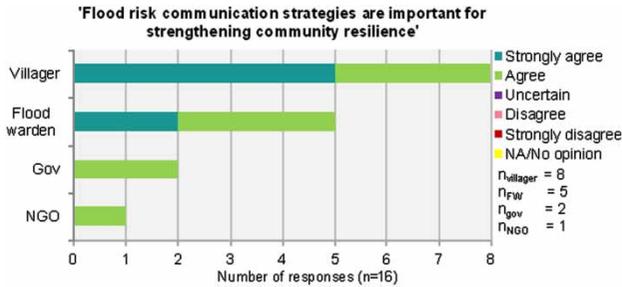
Figure 7 | Respondents' evaluations to the importance of flood risk communication strategies for strengthening community resilience.

From our empirical research, we know that the nature of information communicated through these flood-related activities appears to focus on how to prepare for and respond to floods, while most of the interviewees seem to be less certain on how to recover from and mitigate flood impacts, as reflected in their evaluations to the ranked questions. In general, the flood wardens evaluated more positively and expressed higher confidence in taking the necessary actions throughout the disaster management cycle, as compared to the Toll Bar villagers. This highlights the importance of interactive, two-way nature of flood risk communication, not only during acute flooding events, but the need to maintain this interactive communication

(specifically between the government authorities and Toll Bar villagers), towards better mitigation of flooding risks and facilitation of the recovery process of those affected through a range of communication modes and mechanisms in strengthening the resilience of the community members.

Other influences on the flood risk communication strategies

Drawing on the research findings discussed in previous sections, Table 2 summarizes the factors that had positively and negatively influenced the flood risk communication strategies and community resilience.

We distinguish the occurrence of influences at two levels. The influences at the institutional level refer to the developments or institutional changes that are carried out by the relevant government authorities and may influence other governmental agencies and/or the general public. As for the influences at the non-institutional level, these refer to more localised developments or systems, such as at the village level. Identification of these influences are an important step for further improving communication of flood risks and, ideally, for capitalising on the opportunities for enhancing the resilience of communities. The recommendations
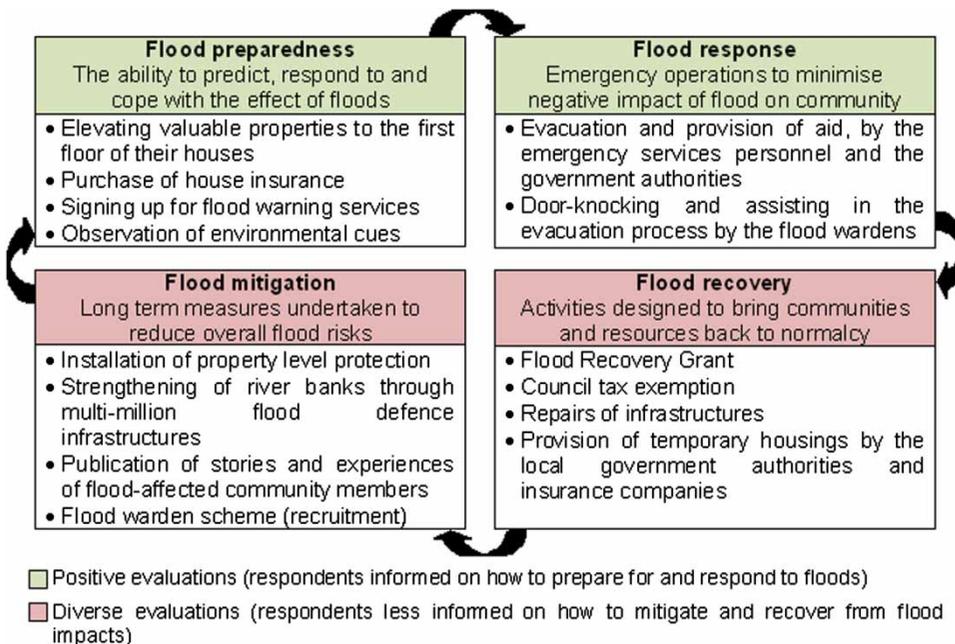
Figure 8 | Activities carried out in Toll Bar during the different stages of the disaster management cycle. *Source*: Structure based on ADPC (2007).

Table 2 | Positive and negative influences on flood risk communication strategies

	Influences on flood risk communication strategies	
	+	−
Institutional level	Technological advancements resulting in the improvements in the quality of forecasts and diversification of communication strategies	No sustainable budgetary allocation for local authorities to support flood-related activities at the village level
Non-institutional i.e. local (village) level	Presence of flood wardens, forging closer relationship with local authorities	Interaction limited to a certain group of people in Toll Bar as the general population exhibits minimal interest in getting involved

elaborated in the next section are intended to address the identified negative influences.

DISCUSSION AND RECOMMENDATIONS

Generally, the respondents acknowledged a sense of progress with respect to the flood risk communication strategies and the level of community resilience, whereby these components were perceived to have improved since the previous flood. Four salient observations have emerged. First, respondents expressed diverse evaluations regarding the characteristics of the current flood risk messages whereby the flood wardens assessed these more positively than the Toll Bar villagers. Second, respondents expressed diverse opinions regarding the current level of interaction between the villagers and government authorities, with an indication that the flood risk communication strategies adopted are progressively moving towards two-way interaction. Third, most of the respondents confirmed the incorporation of villagers' feedback into government planning processes. The flood wardens appear to have higher accessibility to direct communication with selected government officials. They also appear to possess a more in-depth understanding of and interest in their local area and history.

Despite the noticeable efforts by the local authorities to establish stronger relations with the at-risk community in Toll Bar, especially after the devastating flood in 2007, several negative influences were identified, resulting in the following recommendations. In Toll Bar, community events such as Open Days and monthly meetings proved to be paramount for highlighting the developments achieved since the previous flood and hence should be consistently organised in an effort to reassure the villagers, despite the fact that these events have not been completely successful in amassing crowds of villagers. These events provide an excellent venue for fostering community ties, sustaining flood memory and a platform for key local government representatives in interacting with the locals. The element of face-to-face interaction seems to be very much valued by the villagers despite the increasing popularity of ICT-mediated communication modes (Wehn & Evers 2015). Such events should be taken as an opportunity to highlight the importance of taking individual responsibility to mitigate impacts (Cutter et al. 2013) and to focus on the value of individual participation in a community (Mullins & Soetanto 2013). Flood education should be integrated at the school, not only to instil a culture of prevention and preparedness from a young age, but also encourage intergenerational learning of school-aged children with their families. Disaster risk education in school should be a priority as children are among the most vulnerable to disasters (UNISDR 2007). The Toll Bar flood wardens plan also states the same, where children are considered as the primary priority in any disaster event due to their vulnerability. Issues pertaining to the recovery from and mitigation of flood impacts should be given more emphasis as it was evident from the respondents that information related to these two phases appear to be lacking.

CONCLUSIONS

As a response to the recent UK flooding, a National Flood Resilience Review is currently taking place to better protect the country from future flooding (DEFRA 2016). The review will be published in summer 2016. In this paper, we have examined the current flood risk communication practice in a local community in the UK and identified factors to

strengthen community resilience. Our findings and case-specific recommendations highlight the impact of interactive, two-way nature of flood risk communication throughout the disaster management cycle. Acute flooding events (including the preparedness and response phases) present plentiful opportunities for coping, learning, adapting and thus strengthening community resilience, aided and supported by relevant flood risk communication. Although often associated primarily with actual flood events, our findings suggest that (interactive) flood risk communication should also pay attention to the recovery process of those affected and to preventive actions to mitigating flood risks by keeping flood memories alive (in a sensitive and appropriate manner) and, through a range of communication modes and mechanisms, strengthening the resilience of various target groups. Considering the links between flood risk communication and community resilience throughout the course of the disaster management cycle, their interactions become clearer and these can thus be harnessed to strengthen community resilience further.

ACKNOWLEDGEMENTS

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