FLOOD-RELATED RISK EDUCATION AND COMMUNICATION

EDUCACIÓN Y COMUNICACIÓN SOBRE RIESGOS ASOCIADOS A INUNDACIONES.

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Abstract

While flood disasters result from the interaction of natural and human factors, the human dimension is still sometimes underemphasized in flood management. This paper discusses the role of non-structural measures for flood management processes, such as risk preparedness, emergency responses and rehabilitation. Specific emphasis is given to the role of human capacities, in particular water-related risk education, training and communication, on the mitigation of flood impacts. Flood risk education (at the primary, secondary and community levels, as well as at the technical and higher levels) and communication strategies (actors, channels and message content) provide a valuable contribution to the social dynamics of flood risk perceptions, preparedness and vulnerability. This study further highlights the importance of active stakeholder participation before, during and after flood events, as well as the integration of general public perceptions in flood damage analysis and risk management.
Keywords: Flood, risk perception, risk management, human capacities, education, communication, training.

Resumen

A pesar de que los desastres por inundaciones sean resultado de factores naturales y humanos, su dimensión humana está todavía a menudo subestimada. Este artículo analiza el papel de medidas no estructurales dentro de los procesos de gestión de inundaciones como preparación de riesgos, respuestas de emergencia y rehabilitación. Se da un énfasis específico al papel de las capacidades humanas, en particular la educación, entrenamiento y comunicación de riesgo, en la mitigación del impacto de inundaciones. La educación de riesgos asociados a inundaciones (en los niveles primario, secundario y comunitario, así como los técnicos y superiores) y las estrategias de comunicación (actores, medios y contenido de mensajes) ofrecen una contribución valiosa para las dinámicas sociales de percepción, preparación, capacidad y vulnerabilidad de riesgos de inundación. Este artículo subraya la importancia de la participación activa de los actores envueltos antes, durante y después de los eventos de inundación, así como la integración de las percepciones del público en general en el análisis de daños por inundaciones y en la gestión de riesgo.
Palabras clave: Inundación, percepción de riesgo, gestión de riesgo, capacidades humanas, educación, comunicación, entrenamiento.

INTRODUCTION

Floods were responsible for 43% of recorded disasters from 1992 to 2001, affecting over 1.2 billion people worldwide (WWAP-UNESCO 2009). Flooding can seriously disrupt human societies via a series of impacts, which include loss of human life, health hazards, damage to property, and the disruption of transportation systems, water supply, sewage systems and power supply. Floods can be particularly devastating in developing countries, which are less prepared to cope with disasters (WWAP-UNESCO 2009). In addition, the poor suffer most of the burden, as they lack capacity to prepare and respond to natural disasters.

The traditional perspective that floods are entirely natural disasters has been challenged over the last decades. While strongly associated with natural factors, such as rainfall, topography and runoff processes, the impact of flood hazards is conditioned by human behaviour and vulnerability. An early study of the responses of two separate communities to the same transboundary flood event found deep differences in terms of flood impacts due to differences in the political, social structure and cultural values of these communities that are reflected in different levels of vulnerability (Clifford 1956). Human vulnerability can be defined as “a condition or process resulting from physical, social, economic and environmental factors, which determines the likelihood and scale of damage from the impact of a given hazard” (UNDP 2004). The human dimension of floods embraces a series of components, from stormwater management and institutional capacities, to household preparedness and emergency responses, among others. These non-structural components rely on human capacities, in terms of education, training and communication (Szöllösi-Nagy and Zevenbergen, 2005). Even if floods cannot be entirely prevented, flood preparedness, emergency planning and adaptation can significantly mitigate their consequences to a considerable extent. These rely on human capacities, both

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at the public and private levels, and are conditioned by education, training and communication. and precautionary flood preparedness.

Other human-related factors that contribute to flooding are land use changes such as urbanization and deforestation of the catchment basin. Urbanization implies the transformation of natural land surfaces into impervious surfaces that block the percolation of water into soil. This has important effect on stormwater hydrology, due to the increase in runoff volumes and peak discharges. The increased flow velocity of water over the surface leads to a higher frequency of flash floods, with higher associated casualties and property damages. The period of rapid urbanization that was observed during the last decades is likely to contribute to an increase in urban floods. For the first time in human history, most of the world's population now lives in urban areas. Unplanned occupation, unsustainable planning and building practices, which are often associated with rapid urbanization, can further magnify flood risks (Szöllösi-Nagy and Zevenbergen, 2005). In addition, rapid urbanization has also lead to the significant increase of peri-urban areas, which can be significantly vulnerable to floods. For instance, as noted by Tucci and Villanueva (2005), flood impacts in urban areas are often associated with population settlements established during dry years on flood plains and hill slopes combined with the increase of impervious areas. .

Andjelkovic (2001) suggested a characterization of flooding aspects that are differently addressed for rural and urban conditions:

- climatic aspects: "deals with the climatic conditions that may lead to the occurrence of floods. In urban conditions, short and intensive showers proved to be just as critical as long lasting rains, but in rural conditions long lasting rains over an area-wide territory, accompanied with snow melting in the river basin, are recognised as possibly more influential."
- social aspects: "deals with the way the floods occur in different settings. In urban conditions, one can negotiate the intensity and frequency of the disruption of public life and traffic, whereas in regional conditions the common term is disaster, although there were many situations where local urban flooding had disastrous consequences (casualties and property losses) as well. However, floods do not necessarily always need to be associated with disastrous consequences."
- economic aspects: "deals with the issues of financing the capital improvement, operation, and maintenance of flood protection schemes. Local stormwater drainage and flood protection is usually financed by local revenues, such as local taxation, service fee, or user charge fee, collected on the basis of land use, whereas the regional protection is mostly carried out through general taxation."
- institutional aspects: "deals with the role of governments in the process of decision making. In local conditions all major decisions are made by local governmental institutions and water-related companies, whereas in regional issues federal government and ministries take over the full responsibility. Increasing participation of non-governmental organisations is becoming noticeable as well."
- technical aspects "deals with the concepts and works usually applied in flood protection. In urban conditions, the "dual drainage" concept is most commonly applied, introducing the distinction between the stormwater drainage service and urban flood protection, whereas in area-wide conditions flood control measures are always regarded as a part of the regional or state-wide flood control schemes.

Flood impacts come from the combination of these multiple aspects, which have consequences for integrated policies and risk management frameworks (WWAP-UNESCO 2006). On one hand, institutional coordination and management mechanisms need to be strengthened via the promotion of national disaster prevention forums including stakeholders. On the other hand, risk management strategies should address the preparedness of societies to deal with floods, taking into account risk perception issues by individuals and communities, and by developing education and communication approaches.

Education, training and communication at all levels have a key role to play in several stages of flood risk management, from preparedness stages (e.g. management, planning), to emergency response measures (e.g. management and coordination of communication and public information) and rehabilitation measures (e.g. causality and damage assessments and reporting, claim processing, psychological assistance, reconstruction efforts). While this paper focuses mostly on education, training and communication of communities and the general public, some brief remarks will be included regarding technical and institutional levels.

STAKEHOLDER PARTICIPATION

Urban flood management approaches are likely to prove counter productive in the long-term if they fail to enhance the capacity of individuals and society to cope with floods (Szöllösi-Nagy and Zevenbergen 2005). Self-protective measurements by residents of flood-prone urban areas can be particularly effective and may reduce the monetary costs of floods by 80% in some regions (Grothmann and Reusswig 2006). Moreover, active stakeholder participation implies the recognition that disaster preparedness is a joint re-

sponsibility of public authorities and the people. On one hand, it is virtually impossible for authorities to take efficient action against flood risks without public involvement and cooperation, in terms of self-protective measures and compliance with emergency instructions. It is also important for authorities to have a clear perspective on public perceptions, capacities and expectations. Thus, a key challenge on flood damage research consists integrating the social dynamics of flood risk perception, preparedness and vulnerability, in flood damage analysis and flood risk management (Messner and Meyer 2006). On the other hand, the public needs active support from authorities, among other issues to receive warnings about imminent floods, to receive information and coordination on the measures to be taken before, during and after flood events, and to promote learning on self-protective measures.

Several benefits of involving stakeholders in disaster risk reduction have been identified and include the following (Affeltranger, 2002; adapted from WWAP-UNESCO 2006):

- Before the disaster:
  - Improved hazard assessment by relying on local knowledge
  - Improved vulnerability analysis by identifying risk perceptions and hidden weaknesses
  - Assessment of self-protective capacity (awareness, knowledge and resources)
  - Assessment of information needs
  - Improved social understanding and ownership of official mitigation strategies
- During the disaster:
  - Helping capacity for relief in the neighborhood
  - Improved understanding of warnings and instructions
  - Improved trust in authorities and relief officials
- After the disaster:
  - Enhanced commitment to reconstruction activities

RISK PERCEPTION OF FLOODS

Risk perception influences flood risk preparedness and protective responses (e.g. Grothmann and Reusswig 2006; Miceli, Sotgiu and Settanni, 2008). Grothmann and Reusswig (2006) developed a model to explain protective responses to floods (damage prevention) based on protection motivation theory. This model hypothesizes that protection motivation is directly influenced by threat appraisal (perceived probability, perceived severity, combined with fear of floods) and coping appraisal (protective response efficacy, perceived self-efficacy, protective response costs), negatively mediated by non-protective responses (fatalism, denial, wishful thinking). The model also hypothesizes that protection motivation is directly influenced by threat experience appraisal and inversely influenced by reliance on public flood protection. Action towards protective responses is conditioned by actual barriers. The model was tested in Cologne, Germany. With particular relevance for this paper Grothmann and Reusswig (2006), found those with more information options of self-protection were also more likely to 1) take avoidance measures (i.e. avoidance of expensive furnishings in the basement and first floor); 2) purchase of flood protection devices (e.g. protective barriers for windows and doors or pumps); and 3) take structural measures (e.g., putting the heating in upper floors). Information was directly related with home ownership and with previous flood exposure and inversely related with non-protective responses and with reliance on public flood protection. Seeking of information on flood protection was considered itself a self-protection behaviour and was regarded by respondents as very easy, not costly and very effective.

Terpstra et al (2006) found that risk perception of floods in the Netherlands could be largely (74% of variance) explained by eight factors: global increase of flood risk, predictability and no dread, no dread and does not affect me, (un)known risk, risk benefit trade off, people exposed, (un)controllable situation and public commitment. On average, flood risks scored as slightly predictable and slightly known (i.e. very slightly above the mean point of the measurement scale). Interestingly, respondents tended to slightly agree that people like them know well the flood risks in the region and that they can estimate the chances of flooding. However they disagree that the risks of floods are well known to experts. Respondents also slightly agreed that the media often exaggerates the risk of floods and that authorities inform them well.

Research in Taiwan compared the perceptions of those that previously suffered from floods with the general public who have never no flood experience (Lin, Shaw and Ho, 2008). Victims have higher perceived risks of floods, and know more about mitigation actions but perceive less control over flood risks than non-victims. Victims tend to pay more attention to flood information than non-victims but at the same time tend to agree less with government plans to alert the public about a flood hazard. There are no significant differences between victims and non-victims regarding trust in the government's capacity for crisis management, trust in experts' capacity to issue flood warnings and trust in the media's reports on flood warnings. Mitigation intentions were found to be inversely associated with powerlessness feelings.

Research in Japan found low levels of acceptability towards flood risks (Zhai and Ikeda 2008). Among other issues, the authors found flood risk acceptability inversely influenced with flood risk perception, budget information on structural flood measures and on preparedness for flood risks. Flood risk perception

was strongly associated with the perception of other risks (e.g. natural disasters, urban risks, diseases) and with the perceived consequences of floods, but only weakly associated with the perception of flood probabilities.

COMMUNICATION OF FLOOD RISKS

The timely issuance of forecasting information and warnings, together with appropriate communication during preparedness phases, flooding episodes, mobilization, evacuation and post-crisis processes are key elements of flood emergencies management. Given the urgency associated with many urban flooding events, it is crucial that standard procedures are clearly established and functional. Research has identified sets of procedures for efficient flood information and communication. Such procedures focus, among other aspects, on the communicator, the communication channel and the message content. Overall, it is important to prepare in advance message maps for flood communication, based on a series of steps that include the identification of stakeholders and of their concerns, the development of key messages and preparation of supporting information (Lin and Petersen 2007).

With regards to the communicator, it is suggested that authorities should establish one main communication centre and designate one single experienced spokesperson for the mass-media. Such “one voice approach” is key to avoid needless misunderstandings due to inconsistent and conflicting messages, associated with the different tasks performed during flood management, that often lead to public confusion and anger. One key factor that is often highlighted in risk communication literature is trust. In order to ensure that people pay attention to the message and that the message is regarded as credible, it is crucial that the communicator is regarded as trustworthy. A series of factors influence trust, including perceptions of care, value similarity, competence, performance, integrity, cooperation, commitment, fairness, consistency, independence, and openness (e.g. Poortinga and Pidgeon, 2003). The ‘one mass-media spokesperson’ approach can be complemented at the local level by community leaders that have access to the main message adapted to the local circumstances and can help to disseminate it for instance in clubs, schools, churches, cooperatives and other public venues (e.g. Martens, Garrelts, Grunenberg, and Lange 2009). Involving local group leaders in flood management can enhance perceived local ownership of planning and relieve efforts.

The communications channels to be used – usually a combination of mass-media and interpersonal channels – should be clearly identified and communication routes should be pre-established to ensure timely communication within the short time available during flood events. These channels can vary according to the community and flood management stage. They usually comprise television, radio, websites, newspapers, leaflets, loudspeakers, emergency professionals, and community leaders. Two-way communication systems are often more reliable than one-way systems (Carter 1980). It is important to highlight that while interpersonal sources (e.g. family members and friends) are often overlooked, their influence on perceptions and behaviour related to water issues seems to be often stronger than that of mass-mediated sources (Doria, 2010). Parker and Handmer (1998) note that much of the flood-related information may be gathered from interpersonal sources and that the scope for personal networks to relay warnings and to contribute local knowledge towards system design appears to be large. In fact, Clifford (1956) noted that those who are warned through personal channels are more likely to believe in the message and to respond. In the United States, where flash floods are the most significant natural hazard and where half of related fatalities are of individuals in vehicles, it was found that barricades and signs often fail to deter motorists from crossing flooded areas (Coles et al. 2009). Most respondents to their survey have driven through a flooded roadway and the most influential factor for their decision is peer behavior, via the prior successful crossing of other vehicles.

With regards to the message content, it can vary largely depending on the stage, uncertainty and potential risks involved. At early stages, it may be simply a forecast of potential risks. While floods can often be forecasted in order to issue warnings for institutions and communities to prepare their response to flood risks, some difficult decisions must be made to issue warnings, as potential for issuing a false warning or retaining a legitimate warning can be high. False alarms may raise skepticism and future inaction (Cola 1996), but the risks involved in failing to issue warnings can be much higher.

The effective issuance of forecasting and warning notices requires a set of human and institutional capacities in place, as well as an enabling framework environment. In the particular case of urban flash floods, these tend to have a higher level of uncertain associated and are more difficult to forecast than tipical rural floods. Such particularly complex cases are likely to cause greater stress and reveal the strengths and weaknesses of the existing flood preparedness and response systems. A strongly coordinated system is needed for the timely preparation and efficient dissemination of forecasts and warnings.

An example of a forecasting and warning system, as provided by Andjelkovic (2001), is composed of six organizational sub-systems:

- Forecasting and warning centre: responsible for collection, evaluation and issuing of warning messages, responsible for monitoring the development of a flood threat and for offering advice and assistance to local emergency organisation; also responsible for training of institutional staff.

- Main emergency centre: coordinate and conduct emergency procedures during flood events.
- Community/local emergency organizations: responsible for specific activities in local areas, such as door-to-door warnings, search and rescue, evacuation of residents, moving valuables, clearing debris, registration and welfare of victims, co-ordination with: police, fire-fighters, medical and ambulance services, local utility companies.
- Other organizations: which may provide assistance and help before, during and after flooding events (e.g. United Nations Organizations, Red Cross, churches, schools, universities, charity organizations, non-governmental organizations).
- Mass media: helps in disseminating information and promoting communication.
- General public: take protective measures at the household and community levels to protect lives and property, may act upon warnings, may follow guidance for evacuation and relocation.

As events develop, more substantial messages are needed. Risk communication templates can be used to guide the preparation of messages to be issued during flood emergencies.

While a frequent recommendation is to keep the message simple, research has found that sufficient detail is needed for the message to be understood and accepted as credible and helpful (e.g. Carter 1980). Lave and Lave (1991) noted that government publications tended to omit relevant specific information on the nature and magnitude of flood risks and on what specific actions individuals can do to protect lives and property. Grothmann and Reusswig (2006) highlighted the importance of communicating not only what actions can be done to mitigate flood risks, but also the effectiveness and costs associated with private precautionary measures. Technical details (e.g. affected areas, time of occurrence, flow rates, duration of peak flows) should be included, along with basic practical issues. These include, for instance, information regarding the status of safety of driking water supply and in case it is disrupted, information about how people can access drinking water (Doria, Pidgeon, Haynes 2006). The development of GIS tools has strong potential in terms of model and mapping development than can be used to support communication. However, risk mapping literacy should not be taken for granted and must be piloted (Haynes et al. 2005).

In practice, there are several challenges associated with warning systems, including technical constraints (e.g. lack of data, modelling inadequacy and differing flood types), organizational constraints (e.g. weak dissemination of information and institutional deficiencies in the coordination of joint measures for risk management and disaster prevention) and social and cultural limitations (e.g. poor understanding of warnings, limited ownership, conflicting information sources and resistance to follow guidance and instructions) (WWAP-UNESCO. 2006). Social and cultural limitations can to some extent be adressed by user-based design approaches of warning systems, which enhance the warning interpretation, improve ownership and may decrease resistance to guidance and instructions. Therefore, it is crucial to involve stakeholders in the preparation and design of the warning and communication system (Affeltranger, 2002; McDaniels et al., 1999).

EDUCATION

Education is essential for effective disaster risk reduction. It contributes to save lives, prevent injuries and property damage, and helps to develop resilient communities that are able to minimize the economic, social, and cultural impacts of disasters (UNESCO 2010a). Moreover, research has found that formal education is sometimes linked with risk perception of flooding and the adoption of protective behaviours among the general public (e.g. Lave and Lave 1991). In this sense it is important to link early warning systems to education processes, so that there is clear communication between the authorities involved in both realms and so that learners and teachers receive up-to-date information.

The importance of education lies in preparedness, response and recovery, i.e. before, during and after a disaster has occurred. Even after a disaster strikes, education provision provides important life-saving and life-sustaining information. Education can provide physical protection, and strengthen the cognitive and psychosocial coping skills of learners. It can protect children and youth from exploitation and harm, which they are more vulnerable to following a disaster. It can be instrumental in disseminating vital information, for example, concerning safe drinking water; and it can provide a sense of normalcy, stability, structure and hope for the future in emergency situations. A valuable resource for policy makers and practitioners in education in emergencies is the Inter-Agency Network for Education in Emergency's (INEE) Minimum Standards for Education: Preparedness, response, recovery (Nicolai and Triplehorn, 2003).

An efficient response to flood hazards requires adequate education and training at all levels. At the technical and higher levels, education is needed for those directly specialized in flood risk management. This concerns a variety of technical disciplines, such as hydraulics, hydrology, meteorology, engineering, geology, geographic systems, economics, and psychology, among others. Anecdotic evidence at the global level suggests that the number of adequately trained professionals involved in risk management is

far from enough to meet the challenges, particularly in developing countries. It is recognized that global changes, including urbanization and floods, imply an urgent need for highly qualified professionals in water and education (UNW-DPC, UNESCO, BMU 2009). Unfortunately, the scarcity of professionals in these areas only becomes evident during disasters. As a consequence, investments in this area often tend to fall short of the needs unless catastrophic flood events take place.

It should be noted that most of the key decisions affecting water issues are made outside of the water sector, by people with little or no education in water (WWAP-UNESCO. 2009). Public knowledge about flood processes is sometimes reported as scarce (e.g. Lave and Lave 1991, King 2000). Formal education can only influence the adoption of protective measures by individuals if flood-related education is adequately integrated into formal, informal and non-formal education. In areas where access to formal education is limited, which is often the case for those most vulnerable to disaster risks, authorities may help to ensure that messages are shared with non-formal education; there are clear links and opportunities to work with 'public information' and communication schemes on this account. Moreover, when developing flood management plans, authorities and flood experts should not assume that the general public has any specific knowledge about an event that may be relatively rare at the local level (i.e. in the case of the '100 year floods'), about which they had virtually no opportunities to learn about. It is therefore crucial that such learning opportunities are provided, particularly in flood-prone regions, via education and training programmes.

Education is also essential at the primary, secondary and community levels for all stakeholders in a life-long learning perspective. Adequate education in these contexts requires capacities of teachers, educators and media professionals to promote learning about floods. This implies knowledge across a variety of topics, materials and an enabling environment. While teachers are often likely to be well prepared in disciplinary terms (e.g. to teach geographic aspects of floods), knowledge on practical aspects (e.g. how a rescue system works) and the enabling environment (e.g. curriculum integration and professional development opportunities on flood-related issues) may need support (Chang, Chen and Chen, 2010). It should also be noted that serious flood events may seriously disrupt education systems and teachers should also be prepared to respond to floods. (e.g. Machtinger 2006/07). Education systems should also be prepared through the development of contingency plans. In what concerns the physical aspect of education facilities, is important to ensure that schools are not built on flood plains, or areas susceptible to floods and that education authorities have the professional support to determine whether an education facility is safe for use after a flood.

The provision of information and warnings is a distinct process from flood education. However, there are several links that should be considered. On one hand, literacy and related skills are valuable to correctly read and/or understand flood warnings and to interpret flood related information. One the other hand, the provision of flood risk warnings and information to intuitions and communities is futile if people do not have the knowledge and skills needed to respond adequately. In fact, lack of response capacity may only trigger frustration or inadequate responses that may further enhance risks during floods. Moreover, during flood disasters it may be impossible to provide timely information and instructions. This may happen for instance in the case of communities that became isolated and which will need to rely on their own capacities (King 2000). This is also often the case during particularly fast events such as flash floods (Siudak 1999).

Similarly to the development of communication strategies, flood education should be systematically developed and take into account public perception and stakeholders perspectives (e.g. Becker et al 2008).

In that regard, the DRR school programme following the floods in Namibia is an example of education project in floods that not only integrated disaster risk management knowledge in the school curricula, but also in the relevant training and learning programmes for stakeholders including development planners, emergency managers and local government officials (UNESCO 2010b).

CONCLUSIONS

The impact of floods is result of the interaction of several natural and human factors. Water-related risk education and communication are essential to strength the human response to floods. Education at all levels and communication have a key role in different stages of flood risk management, including preparedness, emergency responses and recovery.

This paper highlighted the importance of establishing clear and functional procedures for risk communication. Concerning education, it was noted that a holistic approach at all levels of education is necessary to strengthen public understanding and skills to cope with flood risks. Among other issues, this implies that teachers are capacitated to provide adequate learning opportunities in such complex multidisciplinary topic. In both communication and education processes, risk perception issues must be taken into consideration.

The role of non-structural measures such as education and communication remains under-researched and is often overlooked in formal flood risk management processes. However, human capacities and vulnerability have a central role in flood events and there is some evidence that they can lead to a very significant reduction of flood impacts, both in terms of human lives and property. In this context, educa-

tion and communication certainly deserve higher attention and priority from those directly and indirectly involved in flood risk management.

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