Recommendations

FOR FLOOD RISK MANAGEMENT WITH COMMUNITIES AT RISK

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SUMMARY

This paper represents the final deliverable of FLOODsite Task 11 “Risk perception, community behaviour and social resilience”. It is based upon conceptual and empirical work of three research institutes from Germany (Helmholtz Centre for Environmental Research, UFZ), Italy (Institute of International Sociology, ISIG) and the U.K. (Flood Hazard Research Centre, FHRC) between 2004 and 2007. In this time, the authors of this document investigated what flooding means for the people living in the floodplains of large European river basins or their mountain areas and valleys at risk. By taking into account examples from Germany (Mulde river), Italy (Adige/Sarca and Tagliamento rivers) as well as from England and Wales (with a focus on the Thames), we wanted to know more about at-risk and recently affected communities.

The purpose of our sociological and geographical research was to better understand the impact of floods on communities, the role of subjective and intersubjective perceptions, risk constructions and situational interpretations, pre- and post-disaster preparedness as well as the capability and capacity of communities to recover from a hazardous event. All these issues crucially need to be understood in the context of flood risk management. A first step in bringing together these aspects was made in completing the national reports (De Marchi et al., 2007; Steinführer and Kuhlicke, 2007; Tunstall et al., 2007). A second step and major outcome then represents the cross-country report (Steinführer et al., 2007) which summarises main findings of our analysis in a comparative perspective.

The present paper is of another type: It draws lessons from our investigations (and those of many other colleagues) for practitioners of flood risk management and formulates recommendations. This perspective is due to the fact that in our work – as an exception within FLOODsite – we mainly (though not exclusively) focused on a bottom-up perspective, i.e. from the residents of flood-prone and, in most cases, recently flood-affected areas. Their points of view in many respects differ from so-called experts’ evaluations with regard to the way flood risk management should work on several scales. This, however, does not mean that we just replace one perspective by the other. Since we were in close cooperation with decision-makers from different authorities during the entire project, we could also compare and confront their points of view with the judgements of the people at risk.

In the first instance, we address our recommendations to flood risk management professionals, such as flood-practitioners and policy makers at European, national, regional and local levels.

The recommendations formulated in this paper relate to five issues which were crucial for our research in the past years:

1. Flood risk awareness
2. Flood preparedness
3. Flood risk communication
4. Participation in flood risk management
5. Social vulnerability

The recommendations are all structured in the following way:

- The problem
- Our recommendation(s)
- Background and illustration

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Fig. 1: Main subjects of Task 11 research arranged according to the different phases of a flood event  

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1. **What is the background to these recommendations?**

In recent years, between 2004 and 2007, the authors of this document investigated in the course of the EU-funded Integrated FLOODsite Project what flooding means for the people living in the floodplains of large European river basins or their mountain areas and valleys at risk. By taking into account examples from Germany (Mulde river), Italy (Adige/Sarca and Tagliamento rivers) as well as from England and Wales (with a focus on the Thames), we wanted to know more about at-risk and recently affected communities. Our investigations were based both on long-term expertise in the field of flooding (e.g. in England and Wales) and many studies carried out elsewhere (see also the “Suggestions for further reading” at the end of this report).

We started from the assumption that the material damages and mental or physical health consequences of a major flood disaster cannot be explained solely with reference to the event itself and its management. Rather, a long-term perspective is necessary which also takes into account the periods ‘before’ and ‘after’ the water is inundating a populated area. Although the single phases are overlapping, in a simplified way they can be characterised as follows (Fig. 1):

- **Anticipation (first phase)** covers the entire time-span before the crisis itself. The situation stretches from a vague – or even no – idea of a potential flood (which is related to issues of risk awareness and preparedness) to the flood warning, call for evacuation and ad-hoc activities (e.g. taking documents and securing valuables). The disastrous event has not yet happened but behaviour is increasingly directed towards it. Uncertainty about how to interpret the situation predominates among all actors involved.

- **Resistance and coping** (the most important characteristics of the second phase) are necessary from the very moment when the water is inundating people’s homes and their belongings and beyond. The disaster is now happening. Yet, uncertainty still rules with respect to flood damages and further impacts, the next steps to be taken and the time horizon. How the affected people deal with the immediate situation is what we mean by ‘coping’.

- **Recovery and reconstruction (third phase)** relates to the post-flood situation, mainly the efforts to return to some form of ‘normal’ daily life and the long-term consequences with respect to physical and mental health. It also includes dealing with material and physical damages. In the research literature, the time-period immediately after an event is also called “window of opportunity” indicating – though not undisputed⁴ – that this is the best moment for sensitising for the necessity of public and private mitigation measures.

As shown in Fig. 1, the crucial issue of mitigation and adaptation measures stretches between the post- and a new pre-flood situation which is due to their very nature as both reactions to past events and prevention of damages in the course of possible future events. Communication (such as warning or information on precautionary measures) and the involvement of the public in flood risk management are cross-phase issues and highlighted as such in Fig. 1.

Finally, although Fig. 1 indicates a circle of these phases recurring time and again, there are changes going on. Ideally, a new anticipation phase differs from the one described above, in a way that reflects learning and social change or, to put it differently: a new hazard cycle begins which is not a repetition of the one previously experienced.

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⁴ See, for example, Felgentreff 2003.
In our analyses in Germany, Italy and England and Wales, our particular focus was on:
- flood risk awareness, preparedness activities and flood warnings,
- recent flood events and their course from the perspective of those affected,
- coping behaviour, support networks and mitigation strategies,
- short and medium-term flood impacts on material damage, consequences for physical and psychological health,
- recovery from recent flooding and post-flooding mutual support,
- opinions about personal preparatory measures,
- actual behaviour with regard to such measures,
- the importance and role people attach to public flood protection measures,
- personal and community preparedness,
- personal knowledge about flood hazards and public information initiatives as well as
- opinions about decisions on floodplain management.

In investigating these issues we were not interested in the question of whether the people – whom we addressed via personal talks, questionnaire surveys and interviews – were right or wrong in their judgments, whether they were sufficiently or correctly informed and the like. Rather, we wanted to reveal a ‘real-world’ picture of flooding and why certain issues were perceived and evaluated by those affected in the way they were.

Thus, our approach to flooding differs from that of many other flood researchers: we are more interested in people and less in water. Our focus is predominantly on the perspectives of the residents of at-risk areas which in many respects differ from experts’ evaluations. We are strongly convinced that it is necessary to take the residents’ points of view into account in order to make flood risk management in Europe both more effective and more efficient. This, however, does not mean that we

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2 The single reports (De Marchi et al., 2007; Steinführer and Kuhlicke, 2007; Tunstall et al., 2007) as well as the cross-country comparison (Steinführer et al., 2007) are available on the public parts of the FLOODsite website (www.floodsite.net).
just replace one perspective by the other. Since we were in close cooperation with decision-makers from different authorities during the entire project, we could also compare and confront their points of view with the judgements of the people at risk.

To sum up: we want to integrate different perspectives, to include those of residents along with those of people responsible for flood risk management. These include people from national, regional and local authorities and community leaders; in short the people who provided us with a range of information and interpretation in the field of flooding.

2. Why is there a necessity to formulate these recommendations?

In European flood policy and research there is currently much debate about flood risk management. This debate has been evoked, not least, by the great number of disastrous events in recent years resulting in a number of fatalities and high damages to properties. It is increasingly being accepted that it is not possible to protect from all floods and that purely technical solutions are not sufficient. Thus, flood risk management shall take into account the entire hazard cycle covering flood prevention, protection, preparedness, emergency response and disaster management, as well as recovery and lessons learned. This approach is supported by both national and European policies. In particular, the European Floods Directive, in force from 26 November 2007, needs to be mentioned. The Directive foresees as key tools for flood risk management in all member states:

1. Preliminary flood risk assessment (to be completed by the end of 2011),
2. Flood hazard and flood risk maps (by 2013), and
3. Flood risk management plans (by 2015).

The Directive requires that all of these tools shall be made available to the public and that the member states ensure an active involvement of all interested parties in the production, review and updating of the flood risk management plans. This inclusion is definitely a very important step, and in this respect the Floods Directive follows a, by now, consolidated path in European policy. Repeatedly, in a number of directives, regulations, recommendations, action plans and the like, it is stated that no progress can be made in the management of environment, health and safety issues without the participation not only of those directly involved, but of the European citizenry at large.

However, it seems to us, an important step is still missing in order to achieve effective results, that is overcoming the rigid separation between risk assessment and risk management. In the traditional view of the scientific and technical community which is distilled also into the above mentioned documents, the former is conceived as purely scientific, performed by ‘neutral’ experts. While the issue of uncertainty is increasingly being discussed among the people in charge of flood risk management,

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3 See, for example: Brown and Damery (2002), Defra (2005), Schanze et al. (2006), Sorensen et al. (2006), Kuhlicke et al. (2007), Kuhlicke and Steinführer (2007).


5 Just to provide some examples, one can refer to the European Community Action Programmes on the Environment. From the first one, published in 1977, to the current sixth one, covering the period 2002-2012 (EC 2002), public involvement has progressively gained momentum and is now a priority. Also, in order to prepare the required evaluation of the progress made in the implementation of 6th EAP (mid-term review), the Commission broadly consulted interested parties. This included: a Member State consultation, an expert panel meeting, input from social partners, business associations, eco-innovation industry, and NGO. Finally, also an on-line public consultation was held. Worth of notice is also the evolution in the directives on major accident hazards over the past 25 years. The role of the public changed from passive recipient of risk information in the so-called “Seveso 1 directive” (EC 1982) to that of active participant in planning in the so called “Seveso 3 directive” (EC 2003). For an analysis see De Marchi (1991 and 1998) and De Marchi et al. (2001).
assessment, many value-based decisions are not. There is frequently insufficient attention paid to the unavoidable judgments involved in deciding, among other things, which data and sources to consider, how to compensate for non-existing/non-available data, which hypotheses to test, which assumptions to accept, which models to select, how to deal with uncertainties of various types and degrees, etc. Thus, despite the fact that risk assessment requires value judgments at each step (as any professional knows all too well\(^6\)), it is largely presented to the public as a value-free, objective, neutral activity. The results are then fed into risk management, which is recognised as a separate, non-scientifically based, politically constrained, and ‘value-laden’ activity where there is room for different opinions, values, stakes, interests, concerns, specialist and non-specialist knowledge.

In other words, and with a certain degree of simplification, the traditional view of the scientific and technical community maintains that once we leave the scientific sphere of flood risk assessment for the political sphere of risk management, real numbers representing objective facts are (and cannot but be) watered down in negotiation and compromise. As opposed to risk assessment, risk management should and does legitimately take into account a plurality of perspectives as well as knowledge and evidence other than that which is scientifically based.

In agreement with a large number of highly reputed scholars,\(^7\) we maintain that there is a need for opening up the ‘black box’ of risk assessment. This is not to say that the activity is to be taken away from professional risk assessors, whose skills and capacity for judgment are absolutely crucial. Nor do we argue that any non-specialist social actor should take part in the process or that all technical steps must be understandable to any ‘lay’ audience. Rather, our point is that whenever the result of an assessment is provided to an audience (in the form of a number, a probability, an expected frequency, or other) it must be accompanied by an illustration of the procedure through which it has been obtained including the initial and often unproven assumptions as well as the types and levels of uncertainty identified and accepted at any step.

The reasons for our claim are rooted in practical as well as ethical considerations. With regard to the latter suffice it here to recall a ‘right to know’ principle, whereas the former requires a justification in terms of usefulness and convenience. Our view, supported by plenty of examples,\(^8\) is that non-specialist actors can contribute to improve the quality of risk assessments with inputs derived from local knowledge and daily experience. Without this type of insight, the choice of one model or another, the subscription to one assumption or another may be guided by criteria (theoretical or other), which are irrelevant or inappropriate for the case at hand.\(^9\)

The European Council itself encourages this approach in stating that “Risk assessments must be carried out in a multidisciplinary, independent and transparent manner and ensure that all views are heard. They must also report any minority opinions […] in particular if they draw attention to scientific uncertainty” and that “Civil society must be involved and special attention must be paid to consulting all interested parties as early as possible” (European Council 2000).

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\(^6\) Here we refer to judgments based on professional expertise and experience. The ability to select and decide among a number of options and possibilities is precisely what is appreciated in a risk assessor, besides his/her technical skills. The latter are part of his/her professional training, the former are largely developed in a process of learning by doing.

\(^7\) Among others: Wynne (1992); Funтович and Ravetz (1993); Lash \textit{et al.} (1996); Nature (1997); EEA (2001); Jasanoff (2002 and 2004); Strand (2002); Cranor (2006); Wynne and Felt (2007). Another example of such type of participatory action research is the Community Risk Assessment Tool Kit developed by the Provention Consortium: [http://www.proventionconsortium.org/?pageid=39](http://www.proventionconsortium.org/?pageid=39) (last access: 17 December 2008).

\(^8\) See for example: Wynne (1992); Collins and Pinch (1998); Waltner-Toews \textit{et al.} (2006); De Marchi (2007).

\(^9\) By way of an example, let us suppose that a widely reputed expert from, let us say, Southern Louisiana, is called to provide a flood risk assessment for an area in the Alps she has never visited in person. No matter how good she is with calculations and models, she will be impaired from the start, i.e. in the very framing of the problem, if she is provided with no other input than raw data on geo-morphological traits of the area (for an illustration of the misuse of models, see Pilkey and Pilkey-Jarvis 2007).
Not least, inclusive processes (be it in research, risk assessment or other) help consolidate relationships between those who are (willingly) involved, with positive consequences on the definition of shared goals and agreed upon strategies to achieve them. Conflict will not (and should not) be eliminated or avoided, but points of agreement and disagreement will be brought in the open and thoroughly discussed, if not resolved. This consideration is particularly important at the time when a fundamental change of policy is encouraged, which acknowledges the crucial role of the local communities (those at risk and those regularly or recently affected) and in the meantime imposes new demands upon them, as the European Floods Directive as well as other national policies do. Indeed, those at risk are expected to contribute to improved flood protection by implementing personal preparatory measures by their own initiative and at their own expense.

It is therefore compelling to understand the motives, perceptions and the actual behaviour of the people living in the floodplains, the mountains and valleys at risk, but also why they don’t take certain actions. Flood risk management is a great challenge for practitioners, policy-makers and researchers who will increasingly be demanded to talk to and with the people at risk and, perhaps most importantly, to listen to them if the actual outcome is to include them in decision-making processes and overall risk governance. This is one of the main motives for us to formulate these recommendations.

3. To whom are these recommendations addressed?

In the first instance, we address our recommendations to flood risk management professionals, such as flood-practitioners and policy makers at European, national, regional and local levels. In formulating these recommendations and discussing them with people responsible for flood risk management, and with colleagues from the scientific community, we would like to open up a discourse on the following questions:

– What does flood risk management in its current formulation at the EU level (Floods Directive) and with regard to national policies (Water Management Laws, e.g. in Germany) mean for the people at risk? In which sectors will they be involved, and in which not involved?
– Is there a place in flood risk assessment for these people? Which one?
– What can realistically be expected to be their role/place in flood risk management?
– What are the limits of personal preparatory measures in flood risk management and of participation of the people at risk? How can personal and public preparatory measures be meaningfully combined?

The recommendations formulated in the next chapter do not intend to provide comprehensive answers to these questions. Rather we focus on problematic topics which are closely related to these questions.

4. Recommendations for flood risk management with communities at risk

Flood risk management considers the entire hazard cycle (before, during and after a flood event; see Fig. 1). In our research, we were above all interested in the time interval "without water", i.e. the aftermath of a flood which at the same time means ‘before’ a subsequent flood event in whatever far future (or the other way around). This time interval might cover simply weeks or months but also years or even decades. Thus, our recommendations mainly focus on phases I and III (rather than on event management\(^\text{10}\)). As already stated above, both phases overlap or, to put it differently, they are

\(^{10}\) Within FLOODsite, event management was dealt with by Tasks 17 and 19 (see www.floodsite.net).
two sides of the same coin – namely the period of intervening in flood risk awareness and preparedness. Communication with the residents at risk and their participation in flood risk management are crucial in this time interval.

The recommendations formulated below therefore relate to exactly these four issues:

1. Flood risk awareness
2. Flood preparedness
3. Flood risk communication
4. Participation in flood risk management

Moreover, in a final section they will also deal with the important topic of

5. Social vulnerability

which was one of our main areas of research during this project.

The recommendations are grounded in our research activities as described in Chapter 1. But in the course of this work we also took into account (and profited from) an invaluable mass of previous scholarly work conducted by colleagues and ourselves in different areas of the globe.

The recommendations are all structured in the following way:

- The problem
- Our recommendation(s)
- Background and illustration (results of our research, provision of examples/best practices/how-to-do, hints on probable problems in practice etc.)

The reason for this structure is that we do not believe in simple cause-and-effect activities. Therefore we embed our recommendations in certain contexts, illustrate them and explain impediments. We will pin down central problems and give a positive recommendation (“do”), which is supported by some more concrete background information in order to sensitise for the whole range of problems (“be aware of”).

### 4.1 Recommendations concerning flood risk awareness

**The problem:**
It is often recommended to increase flood risk awareness of people living in flood-prone areas – based on the tacit or openly formulated assumption that with a higher degree of awareness people would also better prepare for a future flood.

**Recommendations:**
- **Keep the issue hot in times of no flood event.**
- **Find regular, repeated ways to raise flood risk awareness.**
- **Use different modes and media to raise flood risk awareness (newsletters, handouts, leaflets, SMS, radio and TV spots ...).**

**Background and illustration:**
There are many problems in life about which people are worried. Based on our studies and in line with other research carried out, we want to highlight that being potentially affected by a (major) flood is just one such worry among others. What is more, in comparison with threats like diseases, the loss of a close relative, financial misery, unemployment and the like, from the perspective of the people at risk flooding is not always the most important one. Quite naturally, with a growing time-interval to the last major event, flood hazards take a back seat. Thus, people don’t think about rising waters all the time. What is more, one cannot live (or would not want to live) in constant worry. Thus, even in the
case of a flood event as severe as the 2002 Elbe flood in Germany, the respondents in our investigations ranked flooding (three years after the event) in comparison with other concerns at just a medium position.

Therefore, information, instructions, awareness campaigns of different kinds and via a broad range of media are necessary to generate and ‘update’ flood risk awareness. Good examples for this are to be found in many places, such as:

- annual flood awareness campaigns as conducted in England and Wales by the Environment Agency;\(^{11}\)
- information sheets (like e.g. those of the City of Cologne or the Weißeritz region in Germany);\(^{12}\)
- flood risk and flood hazard maps as required by the European Floods Directive, also available by postcode for England and Wales on the Environment Agency website.\(^{13}\)

From many discussions with flood risk professionals we know that once they have provided such information to the residents at risk, they often feel that they have done their job. Yet, our second recommendation above stresses an issue which is – at least – as important as information provision itself: the **regularity or repetition of such activities**. Be aware that it will take time to change people’s perceptions and attitudes, do not expect them to change overnight. You need to allow for a period of accommodation which will need to be aided by programmes of information provision and awareness-raising. Even better – our third recommendation – is to find **diverse modes** (e.g. via a municipal newspaper, by leaflets, SMS, radio or TV spots) to inform about the risk of flooding, the first and most important actions to undertake in case of a disastrous event and contact details of people responsible for flood risk management. This issue also requires the creativity of those in charge of flood risk management – nothing will be solved for eternity with a one-off “how-to-behave” leaflet.

Neither the new and crucial instrument of **flood risk and flood hazard maps** as demanded by the European Floods Directive – and already realised in many European towns and regions at risk – will solve these problems. On the contrary, new impediments might come into being, such as:

- restricted abilities of quite a few people at risk to understand and interpret these maps in the way they are intended,
- the socially and age-group selective use of web-based technologies (in many places, the maps currently use to be accessible via the internet) as well as different regional access to such media across Europe,
- the time- and manpower consuming necessity of permanently updating these maps at all spatial scales;\(^{14}\)
- the suggestive power of such maps (pretending to display ‘the’ reality),
- economic disincentives to make these maps easily available to the public since flood risk professionals fear that information about risk levels could accentuate anxiety, decrease property value and conflict economic development plans as well as
- political disincentives to make these maps easily available to the public due to different, more permissive policies in the past, e.g. with respect to building licences (reported to us e.g. in Italy).

Yet, **many of the residents** living in flood-prone areas, to whom we talked in recent years, **were indeed aware of the risk** of being flooded once or several times in their life course. This was not based on pure theoretical or statistical knowledge about flood probabilities but usually these people

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\(^{11}\) This and other information is available on the Environment Agency’s web site: [www.environment-agency.gov.uk](http://www.environment-agency.gov.uk) (last access: 18 December 2008).


\(^{13}\) For this and further websites, see the final section 7.3 of this paper.

\(^{14}\) This is not so much an issue in England and Wales as there is a national body responsible for flood risk management.
dispose of personal flood experience or local knowledge held within their communities. In some cases (e.g. the large Elbe flood in 2002, which also affected the areas of our German case study) this experience was related to a very bitter lesson of having lost almost everything after around 30 years with no major flood event.

But a repeated research finding relates to the fact, that – if people had experienced a major disastrous event – they couldn’t believe it was happening (again). Hence flood risk managers also need to take into account a widespread resistance to imagine that one might be personally affected (again). Even when they acknowledge the possibility of being victims of a future flood event, survey respondents tend to concentrate on possible damage to assets and personal belongings rather than considering the possibility of personal injuries or loss of life. We would like to underline that a reaction of denial is not necessarily pathological and in some cases it may even help maintain one’s mental sanity. It can be ruinous however, if it impedes taking positive action.

In any event our research findings, at least in some areas of investigation, show that personal flood experience and flood risk awareness are related, thus there are indeed “lessons learned”. But: we found only weak or no direct links at all to preparedness. Therefore, in the next section we deal with the issue of private and public preparatory measures, which is also a crucial topic with regards to the European Floods Directive.

### 4.2 Recommendations concerning flood preparedness

**The problem:**
The residents at risk are increasingly encouraged to improve their flood preparedness, i.e. to personally take precautionary measures (e.g. to adapt the physical structures of their homes, to change their behaviour or to take up flood insurance).

**Recommendations:**
- Have realistic assumptions about the people and their willingness and interest to get involved in preparedness activities.
- Use the period immediately after a flood event (“window of opportunity”) to convince residents at risk to apply measures which are appropriate to their type of housing and their budget.
- Find regular, repeated ways to inform about different types of preparatory measures.
- Use different modes and media to inform about the different types of preparatory measures (newsletters, handouts, leaflets, SMS, radio and TV spots ...).
- Investigate financial or other mechanisms to aid those on low incomes to adopt these measures.

**Background and illustration:**
Be aware that flood risk awareness does not necessarily translate into preparedness. Whether or not residents at risk take actions is complex and based on many factors. People need to be made aware of the possible impacts of flooding upon their households and communities (e.g. financial, psychological) and to have the appropriate resources with which to act. Overall they need to perceive the need to act. Thus, while awareness (or feeling endangered) relates to attitudes, preparedness has to do with actual behaviour – and with respect to many issues in life, there might be a large gap between awareness and behaviour (e.g. awareness of aircraft emissions contributing to climate change but still choosing to travel by air). To put it differently: one might have experienced (or been aware of) a major flood event in the past but have not changed arrangements in one’s home.

There is a broad range of possible preparatory measures which might be offered ...
• measures with respect to buildings and furniture (such as elevated configuration, shielding with water barriers, waterproof sealing, fortification of cellar and foundation, adapted use or interior fitting of the flood endangered storeys, safeguarding of hazardous substances),
• behavioural measures (such as having the necessary medicine, sufficient food, sandbags as well as important phone numbers at hand but also to be aware of reliable sources for gathering information) or,
• when applicable, flood insurance.

... and not all these measures are applicable to all residents at risk. Rather, their implementation depends on the age and type of home, the household budget, the composition of the household and the age of its members, personal preferences etc. Therefore – as in the case of flood risk awareness – regular and repeated information concerning the necessity for and costs and diversity of preparatory measures is needed.

Be aware that people are bounded in their interest and willingness to inform themselves about flood mitigation efforts, both with regard to personal and to public measures. Our research findings in the different countries revealed that residents of flood-prone areas continue to regard public institutions as first and foremost responsible for their safety. Though personal responsibility in order to reduce damages in case of a flood is not completely rejected, large parts of our survey respondents perceived far-reaching personal preparatory measures as an overload. In spite of personal flood experience (and even disastrous events in recent years), most respondents take no steps to protect their dwellings mostly because they don’t know what to do, have little confidence in available preparatory measures, believe they live in a safe area and (over)rely on structural devices (e.g. dikes). As a major guarantor of their safety they rather perceive ‘others’ – the municipality, relevant agency, the region, the state etc. (depending on the political landscapes which considerably differ across Europe). This is against the intentions of flood risk management which attributes responsibility also to the at-risk people.

To sum up: to adopt personal preparatory measures, to feel informed about public flood protection, to feel prepared and, finally, to be prepared are four distinct issues each of which require different approaches in the course of flood risk management by those in charge.

Another problem which comes up in this context:
Flood risk professionals frequently reported to us that the presence of protection works induces what they called a “false sense of security” in the residents of flood-prone areas which also hinders them in taking up private preparatory measures. To rephrase it more pointedly: Such measures are counterproductive for flood preparedness.

Recommendations:
• Pay attention to the convincing power of structural devices – they communicate very powerful messages, which range from a high degree of safety to a confirmation of

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15 The same expression appears in the document “Best practices on flood prevention, protection and mitigation” prepared by a core group from among the Water Directors of the European Union (EU), Norway, Switzerland and Candidate Countries, which was led by the Netherlands and France: “Structural measures (defence structures) will remain important elements and should primarily focus on the protection of human health and safety, and valuable goods and property. We will have to keep in mind that flood protection is never absolute, and may generate a false sense of security.” (Best practices … 2003, 2; similarly: 22). The document was presented to the Water Directors meeting in Athens in June 2003 and is an update of the “Guidelines on Sustainable flood prevention” by the United Nations and Economic Commission for Europe (UN/ECE 2000).
being at risk, according to type of works and local circumstances. In other words, they are never ‘neutral’, but subject to different interpretations by those at risk.

- Demonstrate creatively to what extent such measures contribute to safety and what their limits are.
- Do not assume that those living in protected areas acknowledge or understand that they are at risk.
- Do include those in protected areas in awareness-raising campaigns.

**Background and illustration:**

Firstly, **dikes, dams, embankments, barriers** as well as effective risk management agencies make people feel fully protected in case of flooding. As was already stated above, people tend to rely completely on these devices and agencies and to delegate personal responsibility for their own safety. Secondly, such measures themselves change the return rates of floods as they intervene in the regular pattern and shift them into more rarely occurring events. For example, a dike constructed to protect a certain area for a flood with a certain statistical return rate will obviously change the occurrence of such events in this area drastically. Furthermore, it is not only the technical measures, but also **agencies’ good performance** which encourages residents’ progressive disengagement with a culture of self-protection, and diminishes personal preparedness and sense of responsibility. By the very presence of such measure, by the change of the return period as well as by the good performance of responsible agencies, the vulnerability of an area may not necessarily decrease in the long-run. On the contrary, it may paradoxically even increase as the capacity of professional risk management results in a **decreasing capacity of the communities at risk**.

But the ‘false’ sense of security is not least produced by heavy investments in structural devices which are, quite logically, predominantly conducted after major flood events – thus in the above mentioned “window of opportunity”, when the at-risk residents shall be sensitised for taking personal precautionary measures. However, why should they think about sandbags, waterproof sealing or permanently raising furniture in the face of structural protection measures which are impressive by their very presence, apparent technical perfection and costs? Heightened dikes, renovated flood walls, new barriers, etc. – all these technical devices hence speak about safety and they are powerful symbols on which people place their expectations of a secure future. In addition, the dominant rhetoric which accompanies the planning and construction of such works is one of full control and related safety as the huge investments involved must be justified. Moreover, most flood risk professionals are as concerned about water as about possible people’s ‘irrational behaviours’, so fears tend to be played down. Of course there is an occasional remainder of ‘residual risk’, but such words are technical jargon, and their chance to capture attention is low against the powerful alliance between the rhetoric of “don’t worry, everything is under control” and the symbolic power of the structural works.

We therefore recommend **creatively making transparent the limits of such protection works**. One example could be to not only fix flood markers about past events in the areas at risk, but also to indicate up to which point existing and planned technical measures offer safety – and what a higher flood wave would mean. This would also allow people, particularly with respect to plain floods, to know better at which level the water will at least ascend when the dikes are overtopped. By fixing signs indicating the level of safety, the expression of a “residual risk” becomes more easily understandable when manifest in the built environment, rather than represented as a statistical number (e.g. return period; see also below Chapter 4.3).

Finally, it is not only structural devices but also **other acts of getting back to ‘normalcy’** by public authorities which signal this sort of control and contribute to the ‘false’ sense of security of the residents at risk. The **reconstruction and rehabilitation of public buildings** after major disastrous
events is one such symbol.\textsuperscript{16} All invitations to prudence to residents in the same area will go unheard. Moreover, any attempt to establish building constraints will appear unintelligible to private actors, as an undue and unjust limitation of personal rights. Public perplexities (and possibly opposition) are more likely to occur when public money is invested in brand-new constructions, whereas it may recede in the case of historical buildings that existed before experience and/or knowledge of destructive floods. However, what seems irrational from a certain perspective is indeed quite reasonable from a different one.\textsuperscript{17} In order to understand people’s behaviours and actions, there is a need to explore their motives. Be aware that what appears as ‘irrational’ behaviour to an external observer may have solid roots in a different type of rationale. Be aware of the possibility of mistaking people’s reasonable behaviour for an irrational one. And, not least: be aware that people can mistake institutions’ reasonable decisions as irrational ones (and act accordingly).

\textbf{4.3 Recommendations concerning flood risk communication}

\textit{The problem:}
Flood risk professionals at different scales often provide information on flood risk in general as well as on the ‘right’ behaviour in the moment of the crisis or before. Yet, people still complain that they do/did not know that they live in an area at risk, how to behave in cases of emergency, and which mitigation measures to take etc.

\textit{Recommendations:}
- Communicate in an understandable way to the people at risk: the easier, the better.
- Avoid purely technical and statistical expressions like “flood return period of 1:50/1:100” (in German: “HQ 50” or “HQ 100”) and the like.
- Do not use statistical probabilities in flood risk communication at all. One alternative way of communication could be to explain fully concepts, assumptions, procedures and rationale for calculations (with regard to flood risk, flood hazard and risk maps).

\textit{Background and illustration:}
For the people living in flood-prone areas, flood risk is not a statistical number. Rather, flooding is either something concrete, related to their personal experience, or indirectly presented to them, e.g. via oral tradition in their families and communities or by flood markers in their surroundings. Flooding then is something which might happen or which happened in the past, irrespective of its statistical frequency distribution. In any case, it is not something to be talked about in numerical terms like “flood return period of 1:100” (in German HQ 100 or hundertjährliches Hochwasser, in Italian piena con periodo di ritorno centennale).\textsuperscript{18} Therefore it is meaningless to talk to the residents at risk in such a technical way – the same is true for expressions like “residual risk” and the like.

We are even convinced that it is much more than just meaningless: Such types of information do convey a \textbf{wrong idea}, since it is not people’s misunderstanding when they (as reported frequently)

\textsuperscript{16(105,887),(878,917)(105,917),(878,947)

\textsuperscript{17} A striking example for this is the Dresden Conference Center, a brand new building on the banks of the river Elbe which was completed (or effectively rebuilt) just after the 2002 flood.

\textsuperscript{18} We are indebted to Toulmin (2001) for the key distinction between rational and reasonable.

\textsuperscript{18} In German there is a twofold problem: First, HQ 100 is purely a technical term (an abbreviation), which is far from self-explanatory, yet frequently used also in public dissemination activities (e.g. on the website of the City of Leipzig, where flood risk maps are displayed). Secondly, there are linguistic pitfalls: HQ 100 refers to 100jährlich (=once in 100 years), but most people wrongly use the term 100jährig (=lasting 100 years). This mistake is also frequent among language professionals, such as journalists: With regard to newly established risk maps a regional daily newspaper reported on the water depth in case of a “50jährig” (=50 years’) flood (Sächsische Zeitung 30 May 2007, 8).
believe that a one-hundred-year flood occurs only once in a century and that after such a major event it will not happen again for another 99 or 100 years. Rather, it is inappropriate use of technical jargon, the understanding of which is, unreasonably, expected to be shared by outsiders. Of course, among ‘the public’ there are also many technicians and specialists, who are familiar with such technical jargon. These people should not be ‘talked down’ or denied technical information.

The same applies for communicating water heights: Only a few people can probably imagine the possibility of a flood wave of 8 or 10 metres height coming down their street. But then, again, such information is meaningless. Rather, it is better to find a significant building or well-known landmark in your area which has this height and to compare the maximum flood wave with this site.

To sum up: the question “Do people understand me” is a good start, but you can do better by asking a different question (to yourself first and then to your audience) “Am I making myself understandable/understood?” Just put yourself in the shoes of who is listening and avoid certain technical expressions.

A similar problem refers to ‘risk language’: Many of those in charge of flood risk management feel they betray their mission by admitting (to themselves and to others) that they cannot take “total care” and grant “total safety”. Thus they fear losing credibility by admitting danger.

Recommendations:

- Speak of both: risk and safety.
- You can talk about risk – people are used to risks in many decisions in their life.
- Yet, sometimes a positive message might be more appropriate to provoke certain behaviour (e.g. the application of precautionary measures): then use “safety” rather than “risk”.

Background and illustration:

Actually, the fear of losing credibility is not completely unrealistic: in those communities where structural devices collapsed during an event, residents held local authorities responsible for the inadequacy of the protection works in which they decided to invest large sums of public money. Moreover, flood risk managers and professionals fear that risk (and especially residual risk) communication can cause undue alarm and anxiety among residents.

At the same time, they lament for the lack of residents’ risk awareness, discredit the idea that a zero-risk situation can be achieved through technical interventions and claim that residents should be made aware of the residual risk. This is a paradoxical situation and it is not easy to find a way out. Yet, flood risk professionals should be aware that people do not necessarily ask for “total safety” or “zero risk”. Most people are used to living with risks and to taking them in their everyday life: for them to feel safe it is not necessary to be convinced that a particular risk is at a negligible level.

Some of our research findings go in this direction and reveal that residents do not equate “being safe” with “being without risk”. Thus, risk and safety are not perceived as the two faces of the same coin. Rather it seems that the two terms orient the respondents’ thoughts in two different, almost opposed, directions. For our interviewees, in particular in Italy, discourses about danger and risk cover issues such as hydro-geological phenomena in general, the characteristics of the flood events (especially their unpredictability and uncontrollability), as well as structural devices19, in particular the presence of protection works. Safety, on the other hand, is associated with civil protection services, voluntary fire

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19 In the German case study, dikes and barriers were – also in daily life language – mainly related to safety. However, this variation might be due to linguistic differences and does not call into question the principal and necessary distinction between risk and safety.
brigades, as well as with informal networks, local ties and mores: therefore safety is basically about trust in the people in charge and in reliable persons.

These findings suggest that reframing the risk- into a safety-communication context can be a way-out. This is supported by communication research findings, which reveal that positive messages (i.e. ‘you can improve your safety if…’) elicit tendencies toward pro-active behaviours and acceptance, while negative messages (i.e. ‘you are at risk if…’) elicit flight and rejection.

Moreover, taking into account the way the residents frame these issues, safety communication should aim to build or strengthen formal and informal networks (i.e. social capital) and reinforce adaptive capacity, especially at a community level. This means engaging not only in a two-way communication process, but also in a continuous and dynamic process of establishing stable relationships among residents, interest groups, organisations, and institutions. Of course, this does not mean that risk communication must be avoided, but that more attention should be devoted to safety communication, taking into account all its practical implications. This communication should not be designed as a mixture of information and education campaigns, but, again, as a continuous and dynamic process, aimed at building and strengthening mutual relationships of trust among residents, interest groups, organisations, and institutions.

A further problem which is likely to arise in this context:
Even if flood risk professionals provide information: how adequately (with regard to the intention of the message) will they be understood by the residents at risk?

Recommendations:
- Collect feedback about the messages issued (e.g. on content, tone and language) via personal discussion with the people at risk or by (professional) questionnaire surveys.
- Approach ethnic minorities – provide material in their mother tongues and collect feedback, too.
- Use ‘peace times’ to check communication weaknesses and design appropriate exercises and drills to improve awareness and effectiveness.

Background and illustration:
Communication experts know: one can never be sure that a message or information is considered by the addressees at all, and whether it is interpreted in the way intended by its authors. Even children’s games make use of this (Chinese Whisper in the U.K., Stille Post in Germany, telefono senza fili in Italy). The message issued is not necessarily (or even only rarely) the one received, actually the opposite is usually the case. The ‘corruption’ of the original message usually occurs along the pipeline, i.e. when it is passed along the chain of command within and/or between involved organisations and authorities.

Thus, controlling for the comprehensibility of the messages issued is even more important than the messages themselves. If local and regional flood risk professionals feel overloaded with this task: there are experts (communication scientists, sociologists etc.) trained to collect and interpret such feedback. Such translation work back and forth – as we did in our research – is worthwhile in order to come to a deeper understanding of mutual perceptions and to avoid incorrect assumptions or reciprocal stereotypes. Use the “window of opportunity” and its aftermath.

Though less in the areas we investigated (with the exception of one region in Italy), the question of ethnic minorities and their inclusion in flood risk management activities becomes increasingly important – in particular in large urban areas. Since language is key to inclusion in many societal spheres, in multi-ethnic areas messages and materials (also the ones mentioned above: SMS, radio and TV spots, etc.) must not be restricted to the language of the majority.
4.4 Recommendations concerning participation in flood risk management

The problem:
In many fields of life, including flood risk management, there are ever more demands for participation and involvement of ‘the public’. But what is a good participation process? How should it be organised? Who should be involved?

Recommendations:
• Stakeholders need to be involved in decision-making processes at time scales and levels appropriate to their interests, knowledge and skills.
• At the beginning of such a process, lay open its desired outcome.
• Ensure that sufficient time and resources are set aside for engaging stakeholders.

Background and illustration:
In the European Floods Directive, the call for public involvement reads in the following way: “Member States shall encourage active involvement of interested parties in the production, review and updating of the flood risk management plans...“ (Article 10). It is generally agreed upon that the stronger involvement of citizens into risk management efforts is important, since
– it may contribute to raise risk awareness and disaster preparedness;
– the local population may provide knowledge that is fruitful for risk prevention efforts and
– the involvement of the public enhances the acceptance of prevention measures.

However, what is seldom reflected on with respect to the involvement of the public is the question of whether (and how) the public wants to get involved at all. It is usually implicitly assumed by the responsible authorities that the public is eager to participate in such processes. Supported by our empirical evidence we think that this assumption is too optimistic.20

A large number of residents maintain that technocratic top-down approaches are dominant in flood management and judge that technicians are the most influential actors in decision processes. Most of those surveyed don’t feel involved in the decision making processes and tend to delegate responsibility – to agencies in charge of flood prevention and mitigation. Thus, precautionary measures and flood defence are first and foremost regarded as pertaining to public institutions. Such attitudes originate a vicious circle. Public authorities feel the increasing pressure from the residents’ demands for assistance and, by positively responding to it, further amplify its magnitude and the citizens’ tendency not to invest in prevention.

To break the vicious circle of delegation of responsibility for safety to authorities, an effort needs to be made to ensure the involvement of local stakeholders in the design of flood management plans and in their periodical rehearsal in order to assure their continued effectiveness. A major prerequisite is the following one: any discourse and/or practice involving public participation must start with a clear and honest statement of its desired outcomes. This essential step is often neglected (either out of inexperience or bad will) with extremely negative consequences for the whole process. Outcomes may be broad or restricted, general or specific, but it is essential that they are made transparent and explicit. Also, they must be shared by all those involved. This of course does not mean that the desired results of a process are the same for all the stakeholders – actually the opposite is usually true.

Such processes of public involvement will also allow for incorporating a factor which is often forgotten: local knowledge. We are strongly convinced that another relevant factor which triggers a

20 There are a number of reasons for disaffection, with some possible overlapping. For example, some people may rely on “system trust”, i.e. be convinced of the reliability of socio-technological expert systems. In other cases, they may just “hope” that technical devices and dedicated personnel are apt and capable (Pellizzoni and De Marchi 2001). Also, some people may feel they have no real opportunity to influence decisions or may have little sense of agency for whatever reasons or they may just be not interested.
decrease in people’s adaptive capacity is the progressive erosion of local knowledge, due to several reasons including migration phenomena and abandonment of traditional lifestyles. This knowledge concerns not only the territory (morphology, dangerous areas, etc.), but also its management (abandonment or exploitation, control and monitoring, etc.) and is fundamental for the local residents not only to understand how to behave in emergencies, but also to foresee and mitigate dangerous occurrences. Its progressive erosion let residents loose the skill to recognise environmental signals, so that they become less and less able (and prone) to enact self-protection behaviours.

Among others, a wealth of information can be found in historical documents,\(^{21}\) which provide insight into re-discovering forgotten sources of hazard, identifying old and new critical spots, and understanding how human factors interact with physical ones to increase or reduce vulnerability. In the Italian case studies, we found that even some toponyms in local dialects hold the memory of past events. These are, for example, Prà dell’Acqua (water meadow) in Romagnano, March (rotten soil) in Bocenago and Slavini (flash floods) in Roverè della Luna. A few respondents pointed that out, referring to verbally transmitted knowledge also engraven in the local designation of places hit by severe flood events in the past. Thus local knowledge does exist, but it has to be dug out from sources which are not normally accessed by risk assessors: libraries, newspaper collections, local archives of different types, elderly people’s memories, etc. In this perspective, risk assessment becomes an integrated activity, which is open to different types of knowledge, be it disciplinary or not.

### 4.5 Recommendations concerning social vulnerability

**The problem:**
There are social groups that are unlikely to be reached via leaflets, SMS or radio spots—people who are not equally prepared for, able to cope with and to recover from a flood event. In the scientific discourse these people are usually referred to as ‘vulnerable’.\(^{22}\)

**Recommendations:**
- **Do not rely solely on glossy brochures**—people might not find, read or be interested in them.
- **Do not assume that vulnerable groups are vulnerable** during each phase of a flood event.
- **Take on board the results from this research**, for example, by:
  - identifying and keeping a register of vulnerable groups and housing within local areas,
  - providing targeted flood warnings to those at risk and particularly vulnerable,
  - increasing awareness-raising activities, particularly targeted at those groups with low awareness,
  - (if applicable) encouraging take up of flood insurance, particularly by groups with a lower social status,
  - improving the ways that insurance claims and property repairs are dealt with,
  - organising local flood action or support groups,
  - providing grants for householders to purchase flood protection products.
- **Build your efforts upon and along existing social networks** in the communities at risk.

\(^{21}\) See, for example, Luino *et al.* (1996).

\(^{22}\) For a critical perspective on the concept of vulnerability see, among others, Handmer (2003), Furedi (2007) and Steinführer *et al.* (2007).
Background and illustration:
According to the literature on social vulnerability, it might be expected that specific social groups within communities, e.g. households with young children, older residents, long term ill or disabled, unemployed, and those on lower incomes or with lower social status would be particularly vulnerable during flood events. Although we found some evidence for groups more vulnerable in certain moments of the flood, the situation is much more complex. Two main findings need to be highlighted: Firstly, no single social variable or set of social variables can be identified to explain all aspects of community vulnerability, coping and resilience in flooding. Different social factors come into play in the different phases of a flood event and, more particularly affect specific behavioural responses and coping activities. Secondly, context is key: both local conditions and event specifics need to be taken into account for explaining vulnerability. There is no universal catalogue of vulnerable groups—social vulnerability to flooding is always rooted in specific spatial, socio-economic, demographic and cultural contexts. Therefore, we do not present such a catalogue here. Thus, it needs to be recognised that the way that individuals and communities respond before, during and after a flood are extremely complex and diverse. Local knowledge, complemented by social-science techniques, might be of help in identifying especially vulnerable groups and locations. Also the social embedding of the people at risk needs to be taken into account. People are embedded in a variety of social networks, both of informal and formal character. The former are made up of kin, friends, neighbours and the like, the latter comprise all relations with official organisations, such as local authorities, civil protection agencies or voluntary fire brigades. While the importance of these social networks – as “social capital” – in the moment of the crisis (anticipation phase, see above Fig. 1) is rather evident and topic of many newspaper stories on “unprecedented solidarity”, their role before and after a disastrous event is often neglected, especially in a long-term perspective. In many cases that we investigated, very or even the most useful behaviour indications for the residents at risk came from formal sources, alone or in combination with informal networks. Most help during and after a major flood event was provided by informal networks, hence family and relatives, as well as voluntary organisations.

Thus, in ‘peace times’ these local networks should also be specifically addressed and involved in the course of flood risk management and communication efforts. Very often they dispose of specific stocks of non-disputed knowledge – they simply “know the river” and “know what to do”. Although in the case of a major flood event, such might also be an impediment (since the affected residents behave as they always behaved because they cannot imagine a situation worse than those already stored in their personal knowledge), it is worth making such implicit knowledge explicit and share it with a greater community – and also to learn about its probable limits.

23 See the literature reviews in Tapsell et al. (2005) and Steinführer et al. (2007).
24 For context-specific analyses see our FLOODsite reports (De Marchi et al. 2007, Steinführer and Kuhlicke 2007, Tunstall et al. 2007). Each of the reports contains a final chapter 7 with tables of socially vulnerable groups in the way we defined it.
25 See Kuhlicke (2008) for a case study in the city of Eilenburg (Germany).
5. Conclusion

The recommendations presented in this paper are based on our conviction that an integrated approach beyond a strict separation of ‘objective’ risk assessment and ‘non-expert’ (‘lay’) appraisals – as discussed in Chapter 2 – is indispensable for effective flood risk management. Again, by encouraging such an approach, we are not claiming that any and every social actor should be brought into the risk assessment business. Rather we address a plea to researchers, risk assessors and all those involved in risk governance to engage in discovering existing ‘live knowledge’ and local resources and to utilise them for improving the quality of risk assessment, let alone risk management.

A further outcome of our research activities worth stressing is, that in spite of all the many cross-European efforts in flood risk management (and flood research) and their significance, context remains key. Each location, its flood history, culture of self-protection, community structure, tenure distribution, and physical conditions, is specific – and all these factors need to be taken into account in order to understand the course and impact of a certain flood and, thus, to anticipate future events as well as people’s behaviour in order to reduce the damages. This might sound rather banal but for the practice of flood risk management it is probably the greatest challenge since the specifics of the single case are so obviously in contrast with the intentions of harmonising and standardising approaches to flood risk management across Europe.

Moreover, while it is probably easier to accept and come along with cross-cultural, cross-national, cross-regional and cross-local differences, we also want to point to the pitfalls of similarities. Issues apparently identical might only seem to us identical simply because we don’t question them. One prominent example in a European perspective refers to tenure: while in some cultures renting a flat is considered as a sign of lower social status – and, thus, of greater vulnerability –, in others (e.g. in Switzerland or in Germany) this causal relationship has to be questioned. There rental housing is widespread also among middle- and partly even upper classes. Hence, home-ownership might have distinct meanings and implications in different cultural backgrounds.

Thus – and this could be regarded as our final and most general recommendation – flood risk management strategies must be accomplished locally and need to be developed in consultation with local stakeholders.

26 An inclusive risk governance approach was recently applied in the EC funded project Trustnet in Action (TIA 2007). The basic idea was to involve local actors as full democratic players in the processes of risk governance, together with experts from different disciplinary backgrounds and public agencies and authorities.

27 We adopt the following definition of governance: “Governance is the sum of the many ways individuals and institutions, public and private, manage their common affairs. It is a continuing process through which conflicting or diverse interests may be accommodated and co-operative action may be taken. It includes formal institutions and regimes empowered to enforce compliance, as well as informal arrangements that people and institutions either have agreed to or perceive to be in their interest.” (Commission on Global Governance 1995, 2).
6. **How can you get to know more about our research?**

If you are interested in our research, you may contact us directly:

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Moreover, you can also have a look on our project website which also has a public section:

[www.floodsite.net](http://www.floodsite.net)

And, finally, there is a number of publications that can be referred to. Below you will find a selection of both our works and selected references from colleagues. Not all of these have been quoted in the text above but they are worth taking into account.

7. **Literature and internet sources**

7.1 **Bibliography**


### 7.2 Suggestions for further reading


49. DKKV [Deutsches Komitee für Katastrophenvorsorge] (ed.) (2003), Hochwasservorsorge in Deutschland – Lernen aus der Katastrophe 2002 im Elbegebiet, Bonn: DKKV.

56. PATEL M (Ed.) (2004), Public Participation in River Basin Management in Europe. A national approach and background study synthesising experiences of 9 European Countries. (Part of Workpackage 4 of the HarmoniCOP Project).
61. TUNSTALL S, GREEN C (2003), From listener to talker: the changing social role of the citizen in England and Wales (Work package 4 of the HarmoniCOP Project).

7.3 Useful weblinks

1. Association of State Floodplain Managers (ASFM; USA): www.floods.org
2. Bürgerinitiative Hochwasser, Altgemeinde Rodenkirchen e. V. (NGO Flooding, Cologne; Germany): www.hochwasser.de

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5. Deutsches Komitee Katastrophenvorsorge (DKKV; German Committee for Disaster Reduction): [http://www.dkkv.org/](http://www.dkkv.org/)
6. Disaster Research Center, University of Delaware (USA): [http://www.udel.edu/DRC/](http://www.udel.edu/DRC/)
12. Hazard and vulnerability research institute – Department of Geography, University of South Carolina (USA): [http://webra.cas.sc.edu/hvri/](http://webra.cas.sc.edu/hvri/)
13. Hochwasserschutzzentrale Köln (Flood Mitigation Centre of the City of Cologne; Germany): [http://www.hochwasserinfo-koeln.de/](http://www.hochwasserinfo-koeln.de/)
15. Katastrophenforschungsstelle Universität Kiel (Germany): [http://www.kfs.uni-kiel.de](http://www.kfs.uni-kiel.de)
17. Natural Hazards Research and Application Information Center (USA): [http://www.colorado.edu/hazards/](http://www.colorado.edu/hazards/)
22. UK Climate Impacts Programme: [http://www.ukcip.org.uk](http://www.ukcip.org.uk)