Perception of flood hazard in countries of the North Sea region of Europe

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Abstract Floods are natural phenomena and flood hazards cannot be eliminated. Thus it is necessary to learn living with this hazard. Floods represent a threat only with respect to human society, giving humans a central role: through location and through perception. Adequate perception of flood hazard is one of the premises to lower the vulnerability of the society and is an important element of non-structural measures for reducing flood risk. Public perception of flood hazard is essential for decision-making at all steps of flood risk assessment. The results of an investigation of the perception of flood hazard in five countries of the North Sea region of Europe are presented. 4000 Europeans living in flood-prone areas have been involved in the study. Stratified polls and focus groups were used as investigation tools. The study revealed many similarities in the perception of flood hazard among Europeans, such as limited interest in flood hazard, passiveness and reluctant attitude towards moving, while, for example, reckoning on flooding of their own houses differed between countries. The collected information offered a necessary background to streamline flood hazard information to laymen as well as for the second phase of the study, namely a search for consensus between public and authorities about what level of risk is tolerable.

Keywords Flood assessment; flood information; non-structural measures; public perception

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Introduction

Floods bringing enormous economic damage and killing people are frequently reported from different parts of the world. *Is the world becoming a more dangerous place?* Although the frequency of extreme floods shows an increasing tendency over recent decades, they are, by definition, rare events. This explains why such events still come as a surprise to inhabitants on the floodplain. These people may have been lulled into a false sense of security by the long period that had passed since the last devastating flood, and by the technical protective measures undertaken (Kundzewicz 1999). We face a paradox when, despite outstanding developments in science and technology, the losses caused by floods increase. Flood risk assessment goes beyond meteorological events, hydrological regimes, flood hazard mapping and technical means (e.g. dams, dikes, etc.). It includes perception of risk by the general public and decision-makers (Krasovskaia *et al.* 2001). As noted by Renn (2004), it is not only the probability and the severity of adverse effects that influence the way people perceive risk but rather the context in which the risk was experienced.

Floods represent a natural phase of river flow regimes and a flood hazard cannot be eliminated. It is the vulnerability of society that should be assessed instead. In the last two decades "resilience" has become the buzzword (World Disaster Report 2004). As it is not possible to provide total flood safety using even the most advanced technical measures, it is

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of vital importance to learn how to live with floods by means of better preparedness, better forecasts, better spatial planning, *better perception of flood hazard* and retrofitting.

Why is it important to study perceptions of flood hazard? Floods represent a threat only with respect to human society, which gives humans a central role: through location and through perception ("anthropogenic" interpretation of a hazard). The protection of the rights of an individual is essential in a democratic society, but protection of the common wellbeing of the whole of society is also important. Risk is a primary factor in many political matters, often more important to the general public than other considerations, and certain facets of the perceived risk are strongly related to the demand for risk mitigation (Sjöberg 1999). Flood risk perception by the general public is thus essential information in decision-making at all stages of flood risk assessment, from preparedness and forecasts to spatial planning and retrofitting.

Flood assessment is typically given to bodies with large administrative powers and tax basis, while most of the impacts are local (Smith 2001). It is important to make these two levels meet. "Governance" is the new catchword to highlight the importance of the soft components of water resources management. A fundamental difference in all governance is between *perceived* and *assessed* problems: politicians and the general public act from perceived problems while experts work with diagnosis-based assessed problems (Falkenmark 2004). More practically oriented and experience-based local knowledge accumulated in flood-prone areas needs to be reconciled with general expert knowledge of flood issues. Knowledge of public perception is essential for elaborating trade-off policies in flood assessment. As noted by Renn (2004), such a trade-off is dependent on both context and choice of dimension, and information on perception helps to select the latter. It also may indicate beneficial improvements in informational policies. The identification of the commonly acceptable comprehension of the flood hazard is a first step in a democratic process of formulating a flood-protection policy backed by the general public.

Many perception studies in connection to floods have been performed during the last decades (e.g. Morris-Oswald and Simonovic 1997; Krasovskaia *et al.* 2001; Horven Skellnes 2001; Perrin and Gendreau 2001; Environment Agency 2004) in different countries. Valuable information about how laymen perceive flood hazard and flooding has been assembled but, unfortunately, in most cases no attempt has been made to incorporate this information directly into flood assessment, and in particular into spatial planning practices. The study presented herein was carried out in the framework of the "Social package" of the European FLOWS (*F*lood Plain *L*and Use *O*ptimising *W*orkable *S*ustainability) project and the ambition was to fill in this missing link, letting perceptions of decision-makers and laymen meet and engage in a dialogue between these two parties in search for a consensus on what risk is tolerable. The main aim of this study was to investigate perception of flood hazard by Europeans living in areas at risk of flooding in five countries of the North Sea region, focusing on similarities and differences and preparing a statistically sound platform for a dialogue with the decision-makers (Krasovskaia *et al.* 2007; detailed information is found in Krasovskaia (2006*a,b*)). Another aim was using this knowledge to develop and test novel approaches to inform laymen about flood hazards.

Investigation tools and sample selection

There are many approaches to study public perception. All of them have their pros and cons. In this study the Expressed Preferences Approach was used – that is, we asked laymen directly instead of studying their behavior in a flooding situation. The poll was carried out in all participating countries in areas at risk of flooding (i.e. stratified polls). The study addressed the population in large flood risk areas in the North Sea region and telephone interviews were considered to be the most appropriate tool. It allows us to collect the views on flooding from many citizens at relatively low cost and provides a statistically sound sample. This method was

found to be most useful in respect to the objectives of the study, namely to get information about *how* laymen perceive flooding hazards. Focus groups that followed the poll in the UK and Norway allowed us to analyse why people perceive this hazard in a certain way. A deeper psychological analysis was beyond the framework of this project.

Interviews with 4000 people were conducted by a professional polling institute (TNS Gallup) as CATI (Computer Assisted Telephone Interviews) in each country and each interview took about 10 min. The poll addressed people living in flood-prone areas in five countries of the North Sea region of Europe: Germany, the Netherlands, Norway, Sweden and the UK. Each partner country selected their sample population in collaboration with the polling institute. The sample sizes were chosen to ensure a sufficient computational accuracy and provide the results within acceptable confidence limits. Table 1 offers information about the sample sizes in each respective country. The "Gross sample" is the number of residents randomly chosen for telephone interviews in the selected area; the "Net sample" is the real number of respondents phoned; the "Complete interviews" is the number of valid responses received. Table 2 (provided by TNS Gallup) can be useful when evaluating the validity of the results concerning the difference between the answers given to a certain question. If, for example, 40% in a sample of 1000 persons responded in a certain way, the confidence margins are ±3%.

Statistical correlations between the way people responded and their personal background (gender, age, education level, economic activity, type of area, residence: rented or owned, household size and structure, time at current address) proved to be rather low for the whole sample studied. To get an insight into the influence of the respondent's background a hierarchical grouping of the respondents with respect to a certain question has been carried out using Ward's algorithm (Ward 1963), keeping the between-groups variance as high as possible and within-group variance as low as possible. The background of the respondents (taken as an average) in the groups with more than 20 persons was then analysed to identify possible tendencies in the influence of the respondents' backgrounds on their answers.

Table 1 Sample sizes in the poll study

Summary statistics	UK	NL	N	SE	D
Survey population	2.6 m	10 228	3438	1583	≈325 000
Gross sample	2184	10 228	3438	1583	9623
Net sample	1874	4727	2810	1566	5275
No contact, total	745	2109	848	201	2630
Refusals, total	329	1822	1162	565	1845
Complete interviews	800	796	800	800	800

Table 2 Dependence of uncertainty margins (%) on the sample size (TNS Gallup)

Size	5(95)%	10(90)%	20(80)%	30(70)%	40(60)%	50(50)%
50	±6.0	±8.3	±11.0	±12.7	±13.6	±13.9
100	±4.3	±5.9	±7.9	±9.0	±9.6	±9.8
200	±3.0	±4.2	±5.5	±6.4	±6.8	±6.9
400	±2.2	±3.0	±3.9	±4.5	±4.8	±4.9
500	±1.9	±2.6	±3.5	±4.0	±4.3	±4.4
600	±1.7	±2.4	±3.2	±3.7	±3.9	±4.0
1000	±1.4	±1.9	±2.5	±2.8	±3.0	±3.1
1500	±1.1	±1.5	±2.0	±2.3	±2.4	±2.5
2500	±0.9	±1.2	±1.6	±1.8	±1.9	±2.0

What do people think about the flood hazard?

The poll study focused on the following topics:

- General awareness and concerns about flood hazard.
- Previous experiences of floods/flood assessment.
- Reasons for living in a flood-prone area.
- Knowledge about flood assessment in home region and information channels.
- Willingness to "buy safety"/adapt to risk (risk–benefit).

In addition, information on personal background was collected (gender, age, education level, economic activity, type of area, residence: rented or owned household size and structure, time at current address).

A questionnaire consisting of 32 questions on the focus topics and 10 questions on personal background was devised and the formulations were adapted for short telephone interviews in collaboration with the poll institute. The original language was English (Master questionnaire) and the questions were translated to the local languages of participating countries.

The poll investigation revealed broad spectra of attitudes, thoughts and plans with respect to flood hazard among the population living in flood risk areas in the North Sea region of Europe. The presentation below follows the focus topics.

This cannot happen to me!

The first block of questions addressed awareness and concerns of population about floods. Some earlier European studies have shown that the flood hazard was ranked very low by Europeans, ranking only the danger of contracting AIDS and being hit by lightning lower (Sjöberg 1999). *Do people in the North Sea region living in flood-prone areas know about the flood hazard and are concerned about it?* Based on the results of the poll the answer is, in general, not really. Only less than half knew that they lived in an area at risk of flooding and only 1–2 in 10, on average, had some concerns about flooding. The differences between the countries were large, however. While in both Scandinavian countries 6–7 in 10 respondents knew about flood hazards in the area, in the UK and the Netherlands 5–6 in 10 and in Germany 9 in 10 were not aware of this (Figure 1).

The knowledge and degree of concern about any risk can be a function of many factors, like, for example age as seen in Figure 2, i.e. it seems to decline slightly with the age of the respondents (70% of the respondents were over 40 years old). Households with children seem to be more concerned about the flood hazard (Figure 3), while gender or education level

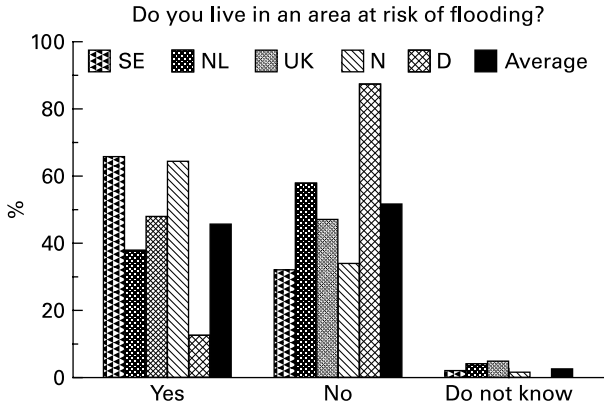

Figure 1 Awareness about the flood hazard (whole sample)

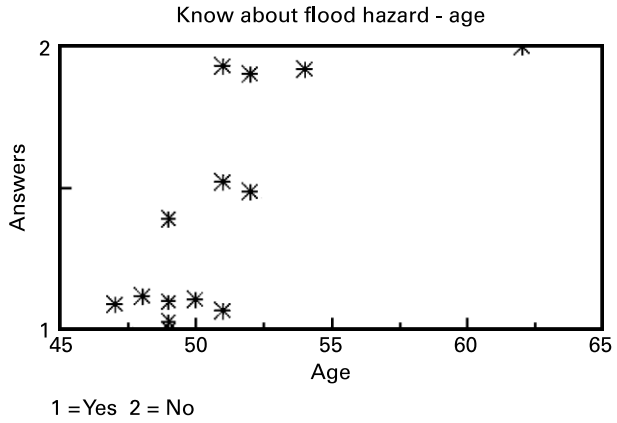

Figure 2 Dependence of knowledge about flood hazard on average age of the respondents in a group

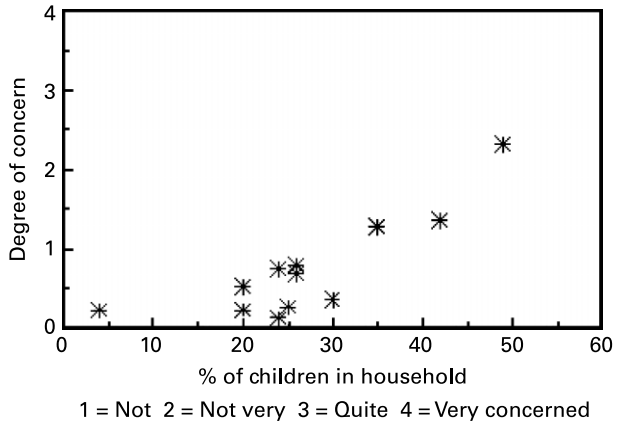

Figure 3 Dependence of concerns about flood hazard on the average percentage of children in household in a group

have not influenced the awareness distinctly. Many other factors might be of importance for the awareness of laymen (e.g. previous experiences, possibility of choice, trust in existing flood assessment policies, personal situation, etc.). However, the fact that about one half of the population living in areas at risk of flooding demonstrated very little concern about this natural hazard might also stem from inadequate information and low degree of public participation in flood assessment issues due to lack of clear/established practices to do this.

A dissonant perception of flood hazard ("This cannot happen to me") is obvious from the way many people answered a question about expectations of a big flood in their area and flooding of their own homes and properties. Seven in ten considered such an event to be quite or very unlikely. Such an attitude is somewhat unexpected from the group of respondents who admitted living in flood-prone areas. One of the reasons might be that the overwhelming majority of the population (eight in ten) had never experienced flooding with the exception of the Norwegians. *Of those few with flood experience* the expectations of flooding of their own homes was pertinent (Figure 4). However, only 1–2 in 10 among them felt to have been in danger during flooding in all the countries, which may partly explain the low concerns about flood hazards. The economic impact of the floods seems to have been rather modest on average for the respondents with flood experience except for the Germans. More than half of them ranked it as very or quite small.

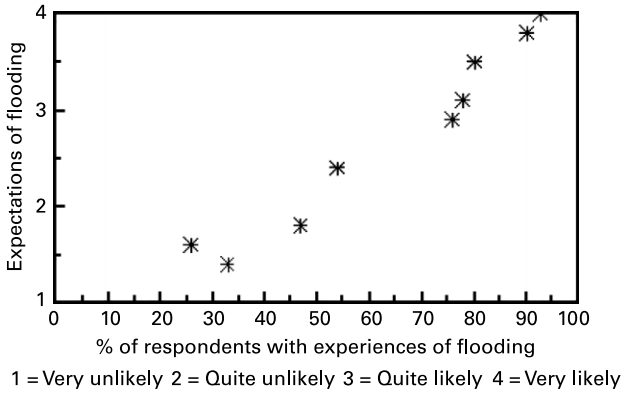

Figure 4 Dependence of expectation of flooding of own home on percentage of respondents with previous flood experience in a group

Beliefs or knowledge?

It seems so far that a flood hazard is not really perceived as a hazard by many. Although such an attitude may have many reasons, knowledge about adequate defence measures undertaken may certainly give a feeling of safety. *But do people really know something about flood protection in their region?* The results demonstrated that, on average, roughly only half of the respondents in all countries knew that there were flood defence measures in their area, although the variation between the countries is rather large. While in Norway seven in ten knew about the flood defences, in Sweden, Germany and the UK only four in ten did (Figure 5).

Personal involvement in flood assessment may bring indispensable knowledge and stimulate greater awareness of flood hazards. Unfortunately, as was evident from the answers, very few citizens have had such an experience (only 1–2 in 10) but the variation between countries is large. *How do people feel about the information on floods received?* Among the Norwegian and British respondents the majority considered the information on floods to be adequate (which is in contradiction to a rather low awareness about the flood hazard demonstrated by the respondents from the UK), while the majority in the other countries were mostly dissatisfied with this information. Traditional information sources like newspapers and radio/TV still seem to be appreciated in all the countries. There was an indication that the degree of satisfaction with the information received increases with the age and education level of the respondent. Unawareness about flood hazard in spite of

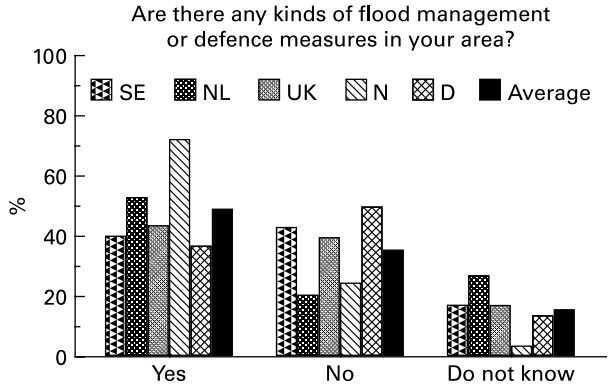

Figure 5 Knowledge about flood protection and defence measures (whole sample)

information provided and/or feeling of information inadequacy among laymen calls for the necessity of reconsidering the ways such information is given to the population.

"A room with a view"

As seen earlier about half of the respondents were not aware of living in areas at risk of flooding, so is hardly surprising that more than eight in ten on average did not think about the flood hazards when moving to the area. It seems, however, that many of those aware of this hazard also did not think of it when moving. Attractiveness seems to be one of the dominant reasons for settling in the area but its importance differed between countries. While in the UK it was definitely the governing reason, its importance was still prevalent but in competition with other reasons in the Netherlands.

Would people consider moving out when they became aware of the flood hazard? As seen in Figure 6, the almost unanimous answer is "No"! Personal reasons seemed, on average, to be rather important for each fourth respondent with a rather large variation between countries. Difficulties in selling the house or finding a job were obviously less important reasons.

False safety and responsibility delegation

On average, nine in ten respondents would never, or rarely, reckon on flooding. The feeling of safety is dominant in the answers and the most obvious reasons are lack of awareness and misunderstanding of the nature of floods ("not happened before", "floods are unacceptable"). Failure to understand the flood hazard correctly results in a passive attitude towards actions to reduce losses: eight in ten on average had not taken any steps to increase the safety of their homes, though the suggested measures did not require any particular investments (e.g. checking the insurance). As seen in Figure 7, such an attitude does not seem to depend much on the respondent's personal background, except for a slightly higher willingness to do something to be better prepared for eventual flooding among females, respondents with previous flood experience and those dwelling at the same address for two to ten years. The differences between countries are very small.

Confidence in existing flood defences seems to be low in general, which may well reflect its insufficiency but also unrealistic expectations of "absolute" protection and poor information. In spite of the fact that attractiveness of the area was the major reason for moving to and staying in areas at risk of flooding, seven in ten respondents would accept

Figure 6 Willingness to move to avoid the flood hazard

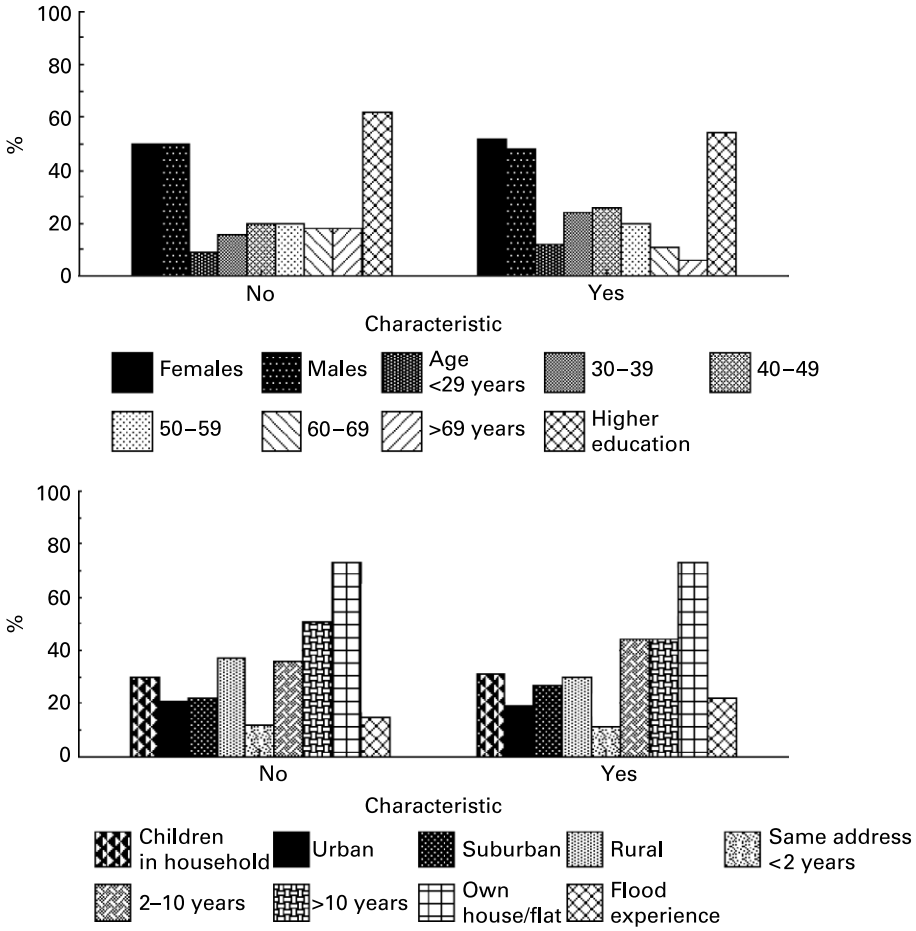

Figure 7 Willingness to invest in flood safety and personal background (whole sample)

major changes in the environment (done by someone else!) to increase flood safety. The acceptance was particularly high in the Netherlands.

Most households clearly prefer to delegate the responsibility for flood proofing to authorities (Figure 8) but, on average, only about half of the respondents confirmed to be very or quite confident in the way public authorities handle the flood hazard. Lowest confidence was noted among the German households. Previous bad experience was the dominant reason for this. The fact that half of the population were not confident with the way public authorities assessed flood hazard might originate from the lack of personal

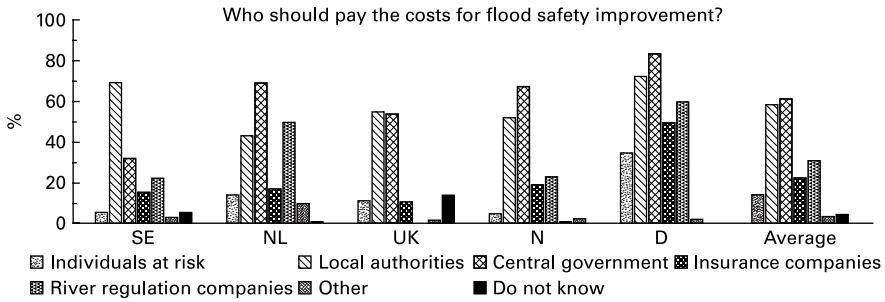

Figure 8 Opinions about responsibility for costs to improve flood safety (whole sample)

experience of such activities but also from the lack of a dialogue between public and the authorities.

Adapting flood risk information

The poll study revealed inadequate awareness of the flood hazard among the population in flood-prone areas. In spite of the fact that such information is available and is considered to be satisfactory by decision-makers (Krasovskaia *et al.* 2007) it does not seem to be perceived as such by the majority of laymen. That is why some non-conventional methods to disseminate information about flood hazards have been employed within the framework of the FLOWS project with the aim to improve the awareness. Different techniques have been used such as school projects; "face to face" distribution of information; broad distribution of information reaching a large number of people (leaflets; seminars; alarm systems; websites) (Skiple Ibrekk 2006). Some examples of the most successful projects are briefly described in the following.

Flooding models in Hamburg and Suffolk

Poll respondents with previous experience of flooding showed a higher degree of awareness about this hazard and demonstrated a higher will to invest in flood protection of their homes. To also stimulate people without such experiences but living in flood-prone areas to prepare for flooding a visualizing approach has been successfully applied: "a living room after flooding" and "flood pipes" in Hamburg, Germany; and "flooded house model" in Suffolk, UK (Perception 2006). The first project demonstrated a real-scale flooded living room and showed the possible level of the flooding water by means of transparent flood tubes placed near the houses at risk for flooding (Figure 9). The second project created a "flooded house model", which showed how and from where a house can be flooded, showing the damage that can be caused including the terrible "sewage" smell that is often left behind in flooded houses. The visualizing approach is an effective way to bring the flood hazard message to people in a comprehensible way, addressing not only their logical thinking but also their feelings.

Using flood symbols

In the past flood levels were carved into church walls and other buildings to remind citizens about the flood danger. With time, however, this message tends to be no longer noticed by

Figure 9 A real-scale flooded living room (a) and a possible level of the flooding shown in a transparent flood tube near the houses at risk for flooding (b) (photo T.R.Geissler)

those passing by. To convey their message the flood symbols need to stand out and be effectively promoted. Some examples of how to achieve this have been demonstrated within the FLOWS project. The Dutch project, a "Flood Symbol Competition" (Perception 2006), was organized among school children. Students were stimulated to actively explore the topic of flooding and helped by an art expert to choose an original design for a water work of art. Twenty original designs were created and students acquired knowledge about floods in an imaginative way. The three winning designs were presented during a public meeting and will be built and placed in the towns of Sneek and Urk in the Netherlands.

In Norway a school project "Building a flood stone" was carried out in Åsnes (Perception 2006). Similar to the Dutch project a school competition for the best flood symbol was organized. The winning design was carved into a five meter high flood stone placed at a considerable distance from the river to indicate that the community was highly vulnerable to flooding unless protected by the dikes. The stone was unveiled on the 10 year anniversary of a devastating flood in Eastern Norway in 1995. The event received a lot of publicity and was attended by many people (Figure 10).

School projects

The expert panel study within the framework of the FLOWS project (Krasovskaia 2006b) stressed the importance of starting the information work about flood hazards early at school, possibly as a part of school education. This will not only improve the preparedness to floods of the future generation but also will help to spread information to the adult population via their children. Both projects concerning flood symbols described earlier involved school children.

In Åsnes, Norway still another project involving the participation of school children has been carried out: "Making a Flood Newspaper" (Perception 2006). The students were in charge of creating a 12 page enclosure to the regional newspaper devoted to flood issues. As they were too young to remember the last flood in their town they learnt about it by asking old people with experiences from flooding in 1995, which is, in fact, a traditional way for children to learn. Such topics as volunteer work during the great flood in 1995 and preparedness for future flood events were also discussed. Not only children but also their families got involved in the project, which received much attention in the mass media. All this contributed to the effective disseminating of information on flooding to the population.

A similar successful project with school children has also been carried out in Cambridgeshire, UK (Perception 2006). A water-themed period of learning was created, where teaching about flooding and climate change was combined with art-based teaching including carving of flood symbols into stones, music and papermaking. Cognitive and creative learning engaged children, who for the first time reflected on the flood theme and also helped to attract the attention of the adult population to the flood symbol created.

"Face to face" information

Many of the respondents in the poll study appreciated "face to face" information about flood hazards. In response to this a project in Norfolk addressed this type of information dissemination (Perception 2006). The venues were organized as a fixed (in a library) and three mobile information events, at each of which officers were present to respond to individual queries and provide consistent advice. The use of a multi-purpose community vehicle equipped with laptops, display boards, etc., proved to be very effective in providing information to more remote rural locations. The project was carried out in collaboration between different institutions and NGO dealing with flood issues which allowed the bringing together of existing initiatives and broadening the horizons by working together.

Figure 10 Raising flood stone with a carved flood symbol in Åsnes (photo NVE)

Leaflets

Results from the poll study revealed a high appreciation for information about flood issues in the form of leaflets that are distributed by the Environment Agency in the UK. This path was followed in the framework of the FLOWS project in Norway, where practical and easily understood information about floods was disseminated to the population in flood-prone areas in the form of a warning triangle, utilizing this well-known symbol for warning (Perception 2006). Besides providing practical advice, the intention with the leaflet campaign was to remind people that they themselves can do much to reduce the vulnerability of their homes to floods. The campaign was accompanied by articles in the mass media advising people to keep the leaflet as a precaution. The leaflet was elaborated on in cooperation between local, regional and national authorities, which helped to consolidate their efforts and exchange innovative approaches.

Conclusions: towards active citizenship

Active participation of citizens is of great importance for acceptable solutions in a democratic society. The poll study brought forward important information about the way people in flood-prone areas of the North Sea region perceive flood hazards. There are more similarities than differences between the countries in the way people perceive flood hazards. We noted:

- Limited interest in flood hazards.
- Poor involvement in flood issues.
- Sentimental rather than logical reasoning for living in areas at risk of flooding.
- Passiveness with respect to raising flood safety of own homes.

- Reluctant attitude towards moving.
- Leaving responsibility to public authorities in spite of insufficient confidence in their ability to handle the problem.
- Acceptance of major changes in environment to raise flood safety.
- Newspapers and radio/TV are still the preferred information channels (except in the UK), but information is insufficient or inadequate.
- Misunderstanding of the nature of floods.

Many studies conducted internationally have shown that people everywhere, regardless of their social and cultural background, use very similar risk criteria in forming their opinions (Renn and Rohrmann 2000). It is the relative effectiveness of these criteria in opinion-forming and risk tolerance that differ. The noted differences between the countries rather concerned the degree of awareness (or rather lack of it), responsibility taking, tolerance to flooding and concerns about it. These differences might serve as an indication of more or less successful practices of interfacing with the population in flood-prone areas and help in the exchange of positive experiences between the countries. The enormous negative impact of flooding in Europe calls for international cooperation on flooding issues. The presented results are unique in the sense that they are based on the analyses of a large *international* sample and can be used for developing such cooperation.

Passiveness and low interest in flood issues call for better information but not in isolation. It is important to stimulate people's engagement in decision-making with respect to flood issues. Practices allowing the involvement of laymen are not readily available yet and need to be elaborated. The access to public knowledge and values granted by public participation is recognised as having a potential to strengthen risk management (e.g. Beck 1992; Healy 2003). More active engagement among part of the population is already noted (e.g. "Flood Forum" in UK) and it is important to actively propagate and use their example and experiences.

In response to the acquired knowledge about public perception of the flood hazard some innovative approaches for disseminating information about flooding were tested. The results of these efforts confirmed the importance and necessity of simple and easily understandable information. They demonstrated the effectiveness of visualizing flood risk and involvement of school children both to teach about flood hazard and as messengers of this important information. Media coverage proved to be very important for the success of the approaches used. Joint efforts of local, regional and national authorities, as well as stakeholders, NGOs and individuals, help the desired message to come across more easily and create a welcome meeting place for information and experience exchange.

This study, besides bringing forward new comparative knowledge, had synergy effects such as triggering awareness about flood hazards and stimulating responsibility taking. The views of laymen revealed by the poll study were later compared with the views of decision-makers on similar topics and a discourse between these two parties was launched in search of a consensus about what risk of flooding is tolerable (Krasovskaia *et al.* 2007). Regular perception studies always bring some new information and in some countries (UK) they have become a tool of flood assessment. As correctly noted by Renn (2004), *public perception and common sense cannot replace science and policy but they can certainly provide the impetus for the decision-making process.*

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