What new demands are made on preventive flood protection in view of changes in the climate and in society?

Bastian Schuchardt¹, Michael Schirmer², Hellmuth Lange³ & Stefan Wittig¹

¹BioConsult Schuchardt & Scholle GbR, Reeder-Bischoff-Strasse 54, 28757 Bremen,

E-Mail: schuchardt@bioconsult.de, wittig@bioconsult.de, tel.: +49(0)421-6207108

²University of Bremen, Post box 330440, 28334 Bremen, e-mail: schi@uni-bremen.de

³Research Centre for Sustainability Studies (artec), University of Bremen, Post box 330440, 28334 Bremen, email: lange@artec.uni-bremen.de

1 Research approach

Within the framework of support activities in connection with "Risk management of extreme flood events" (RIMAX) of the German Federal Ministry for Education and Research (BMBF) the interdisciplinary joint project "Integrated flood risk management in an individualized society" (INNIG) examined the consequences of different communication strategies regarding flood risks and the possible impacts of climate and social change on flood and coastal protection management on the basis of a comparison of the situation in Hamburg and Bremen.

The interdisciplinary research approach was applied through five subprojects (SP) in the natural and engineering sciences, social and political sciences as well as environmental psychology. The central research question can be summarized as follows:

• How can the requirements for flood protection resulting from climate change and the changing social and political conditional framework be integrated into viable flood risk management geared to the guiding principle of sustainability?

The following research focal points were to be treated by the five subprojects in this context:

- SP 1 Risk analysis and regulation (Franzius-Institute, University of Hannover): Quantification of flood risk based on the example of flood protection in the city of Bremen for three focus areas today and in the course of climate change by recording the failure probabilities of flood protection systems and quantification of the consequential damage occurring in the hinterland. Development of options for taking action aimed at risk regulation.
- SP 2 Risk culture (Institute for Environmental and Sustainability Communication, University of Lüneburg): Analysis of locally specific risk cultures, i.e. of the relations between risk communication activities by professional actors, of risk-related media reporting as well as of risk representation and analysis of the population's readiness to act on the issue of floods, on a comparative basis in Hamburg and Bremen.
- **SP 3 Processing risks and risk behaviour** (Institute for Risk, Environment and Health, University of Bremen): Identification of action theory patterns in processing flood risks and supplementing the existing individual psychology approaches to risk perception as well as identification of information to increase the individual and action specific intention for protective measures.
- **SP 4 Political-administrative risk regulation** (Research Centre for Sustainability Studies, University of Bremen): Analysis of the flood protection situation in Bremen and Hamburg with respect to hierarchical, sectoral and territorial integration of areas of responsibility and examination of various profiles of flood risk management in Bremen and Hamburg (discourse analyses). In addition, the consequences of social change for flood risk management were analyzed and room for manoeuvre and restrictions on action in the political field were identified.
- SP 5 Integration (University of Bremen with BioConsult and TZI): Developing a concept for integrated flood risk management, setting up an information platform in Bremen and the surrounding area as a modern tool of risk communication and coordination of the interdisciplinary research process.

2 Risk analysis: Exposition and climate change

The city of Bremen has a high natural **exposition** to floods. The discharges from the Weser, Lesum and Ochtum Rivers join storm tide water levels pressed into the Weser estuary from the North Sea so that specific threats may arise. The existing flood protection system is complex and includes dikes, flood protection walls and control elements, such as flood barriers. The potential damage in the event of failure of the flood protection system is high in general since approx. 85% of the municipal area of Bremen lies below the mean tidal high water level of 2.5 m above mean sea level. As far as the convergence of storm tides and high discharges is concerned, it is relevant whether the meteorological events responsible for that may occur at the same time. For the Weser a low-pressure area over the North Sea causing a storm tide is independent of a depression in the catchment area of the Upper and Middle Weser caused by a rainstorm. Because of the cross-sectional expansion of the Lower Weser due to further development, very high discharges have only a minor influence on the maximum water levels (Brencher et al. 2007).

New demands on flood and coastal protection result from the projected **climate change**. In the case of Bremen, the accelerated rise of the sea level in particular gives rise to need for action in connection with adaptation strategies for flood protection in the medium term (Schuchardt & Schirmer 2005). With regard to the sea level, the scenario analyzed assumes a rise of 55 cm by the year 2050.

In the risk analysis dike breaks were assumed for three focus areas in the Bremen municipal area. The results of the flood simulations carried out at these places show that both the present probability of failure and the damage to assets vary considerably, thus making for a wide variance in the risk today. If the rising water levels in the course of climate change are taken into account, the damage to assets increases by 47% and the risk by 5- to 7.5-fold (Brencher et al. 2007).

3 Social change and vulnerability

Altered requirements of flood and coastal protection also result from social change. The impacts of extreme flood events are not determined on the basis of spatial exposition alone, but also based on the degree of preparation and of risk awareness as well as the differing vulnerability and adaptation capacity of various social groups. Socioeconomic factors have a decisive influence on vulnerability in this context (Lange & Garrelts 2007).

The following aspects of social change were examined in INNIG:

- **demographic change** with the aspects of declining population and ageing to a regionally varying degree;
- **immigration** and **multiculturalization** with frequently difficult integration into German society, deficits in knowledge of German as well as discrimination on the housing and labour markets;
- **individualization** and **singularization**, which intensify due to a rapid increase in singleperson households and labour-market-related mobility;
- increase in **social disparity** and **social polarization**, which especially include poverty in specific urban districts and unemployment as long-term phenomena today and give rise to places of social disintegration;
- **transformation from an industrial to a knowledge society**, in the course of which scientifically generated knowledge penetrates and increasingly influences all spheres of life and this knowledge is spread by means of new technologies; and
- **altered government action**, including altered government structures, reduction in bureaucracy, increased significance of supranational levels, such as the European Union, and efforts to save as some of the major trends.

Social change is particularly relevant for the political-administrative system because the proportion of more vulnerable social groups may rise. Groups having a high degree of social vulnerability include children, persons with physical, mental and psychological handicaps, poor households, immigrants as well as citizens living in social isolation. The more in-depth analysis of the social vulnerability of a society was conducted on the basis of such **vulnerability factors** as socioeconomic status, social capital, knowledge, integration, political influence, age and gender (Lange & Garrelts 2007). Here are selected results of the vulnerability analysis:

• Social groups with increased vulnerability increase in size (e.g. poor and elderly persons, immigrants).

- Multiculturalization increases vulnerability, especially due to language barriers, because in the event of a disaster, for example, warnings and rescue instructions are not always understood by those affected.
- On the one hand, individualization reduces vulnerability by virtue of greater mobility while, on the other hand, it is increased by a lower degree of social integration.
- Transformation into a knowledge society may reduce vulnerability through increased information, stronger networking and improved dissemination of knowledge.

4 Integrated flood risk management

In our view the new demands resulting from climate and social change can best be coped with through integrated flood risk management. This should be based on regional risk management of the complex consequences of climate change (Schuchardt & Schirmer 2007). Measures for preventing and coping with extreme events have to be structured along a chain of effects: Risk analysis that is primarily geared to the natural and engineering sciences and applies probabilistic methods is one of the key elements of social risk assessment as well as derivation and implementation of action options based on that (risk management). In addition to risk analysis and risk assessment, INNIG also looked at the options available for technical-administrative and individual risk regulation as well as strategies for risk communication.

4.1 Risk communication

The background for the analyses in the field of communication activities regarding flood risks was that differences exist in institutional risk communication between Hamburg and Bremen in spite of comparable threats: Hamburg is significantly more active in communicating the (residual) risk than Bremen. Some of the results of the representative survey on risk perception and acceptance are (according to Heinrichs & Grunenberg 2007):

- Most of those surveyed feel that climate change is coming, it is produced by people, is virtually impossible to prevent any more and represents a danger for the future. Over 80% are of the opinion that climate change will intensify the risks of floods.
- There are differences in risk awareness among the residents of Hamburg and Bremen: Hamburg's population has a higher risk perception and, at the same time, greater confidence in flood and coastal protection. Bremen's population, by contrast, has a lower risk perception for current flood risks, but greater concern about the consequences of climate change.
- The probability of occurrence of an extreme flood assumed by those surveyed is high both in Bremen and in Hamburg.

4.2 The information platform

The results of the analysis of risk perception show that communication of the flood risks is meaningful. A prototype for an information platform has been developed in INNIG to improve information and communication of flood risks. The Internet-aided platform compiles the results on risk analysis and control as well as risk perception and communication. Findings in terms of individual processing of flood risks were additionally utilized as the basis for provision of tailored information. The current version of the platform may serve as the basis for an information strategy and support integrated flood risk management in Bremen by virtue of

- improved information on flood risks,
- creation of awareness of flood problems and dangers,
- provision of tailored information on behaviour and action differentiated according to target groups,
- enhanced readiness to take personal precautionary measures,
- the presentation of preparation and prevention options and
- the debate over future handling of flood risks by society.

The information platform is divided into two parts: firstly, general accessible information and, secondly, personal information. It is possible to switch back and forth between the two as desired. The general information is provided in text form and through integration of a geo-client that can visualize geo-data in the form of maps. The personal information is accessible by filling out a questionnaire that

represents the basis for classification into types of action and risk. The result is then the provision of tailored information depending on the questionnaire responses.

5 Recommendations for preventive flood and coastal protection

Among others, the following recommendations can be derived from the results of the individual subprojects of the INNIG joint project as well as of the KLIMU (see Schuchardt & Schirmer 2005) and KRIM (see Schuchardt & Schirmer 2007) projects:

- In the middle to long term establishment of integrated flood risk management as an extension of current approaches is both meaningful and necessary in order to cope with the new demands (in the short and medium term the demands can be coped with by means of the current strategies, established assessment approaches and existing organization).
- The present coastal protection strategy should be extended gradually and in an open dialogue so as not to jeopardize the high acceptance of coastal protection among the public.
- Flood and coastal protection should carry out and/or intensity active risk communication. The latter should also give consideration to the altered demands resulting from climate and social change (in Bremen the responsible administrative department is currently examining whether it wishes to use the information platform developed in INNIG in order to expand risk communication on the part of government agencies).

References

- Brencher, J., A. Elsner, H. Spekker, A. Matheja & C. Zimmermann (2007): Abschlussbericht des Teilprojekt 1: Risikoanalyse und -steuerung. BMBF-Projekt: Integriertes Hochwasserrisikomanagement in einer individualisierten Gesellschaft (INNIG). Franzius-Institut für Wasserbau und Küsteningenieurwesen; Leibniz Universität Hannover.
- Heinrichs, H. & H. Grunenberg (2007): Abschlussbericht des Teilprojekt 2: Risikokultur Kommunikation und Repräsentation von Risiken am Beispiel extremer Hochwasserereignisse. BMBF-Projekt: Integriertes Hochwasserrisikomanagement in einer individualisierten Gesellschaft (INNIG). Leuphana Universität Lüneburg.
- Lange, H. & H. Garrelts (2007): Abschlussbericht des Teilprojekt 4: Politisch-administrative Steuerung. BMBF-Projekt: Integriertes Hochwasserrisikomanagement in einer individualisierten Gesellschaft (INNIG). Forschungszentrum Nachhaltigkeit, Universität Bremen.
- Schuchardt, B. & M. Schirmer (2005, ed.): Klimawandel und Küste. Die Zukunft der Unterweserregion. Umweltnatur- und Umweltsozialwissenschaften, Springer, Berlin, Heidelberg, New York, 341 S.
- Schuchardt, B. & M. Schirmer (2007, ed.): Land unter? Klimawandel, Küstenschutz und Risikomanagement in Nordwestdeutschland: die Perspektive 2050. oekom-Verlag, München, 243 S.