Precautionary and Sustainable Flood Protection in Germany – Strategies and Instruments of Spatial Planning

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Key words: Spatial planning; regional planning; land-use planning, sustainable development, hazard zoning; flood management; interregional co-operation; risk management

SUMMARY

The article describes the several existing and planned instruments, strategies and measures for flood protection and flood management in Germany. Due to the fact, that the frequency and intensity of floods in central European river basins have clearly increased in the last few years, various new legislative regulations at federal and state level (e.g. Federal Regional Planning Act, Water Management Act, Town and Country Planning Code, Federal Building Code) and superordinate guidelines (principles, objectives and guidelines of land-use planning and regional development) have improved the general conditions for flood control measures. Whereas current management strategies tend to favour structural large-scale defence measures, such as dikes, dams etc. one can notice a change of paradigm towards non-structural flood protection measures, such as flood plain management, flood forecasting and warning systems as well as preventative risk reduction by spatial planning.

In this paper, the focal point of the considerations consists in spatial planning measures for damage and risk reduction such as the prohibition of constructional development out of flood plains as far as possible (land-use control), the removal of flood-prone development for existing built-up areas in flood plains to minimise the vulnerability or conversion of the land to a conforming use. Some of the most controversially discussed issues are the questions, if settlements and infrastructure should be rebuild at the same place or relocated in case of periodical flooding and if further development of areas liable of flooding should be allowed.

Because of the complexity of flood prevention, there is a strong need to cooperate not only across different disciplines but also over several levels or scales of planning and decision-making. This includes different administrative levels (Land (state) planning, regional planning and urban development planning) as well as various types of organisations (governmental, public, municipal, private).

In addition to these questions, the article specifies international flood protection activities for some river basins such as Rhine, Elbe, Danube, Oder, Meuse, Moselle and Saar, where flood action plans already exist or are currently being developed.

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1. INTRODUCTION

1.1 Background Information

Floods are defined as significant rise of water level in a stream, lake, reservoir or coastal region (UN-DHA, 1992). They are generally caused by extreme weather conditions, which can be either rain or snow, in combination with specific weather constellations.

In comparison with other natural disasters worldwide (earthquakes, droughts, wind storms, volcanos, landslides/avalanches, forest fires, technical disasters) floods have the largest damage potential of all and affect the largest number of people. Flooding causes over one-third of the total estimated costs and is responsible for two-thirds of people affected by natural disasters (UN, 2004).

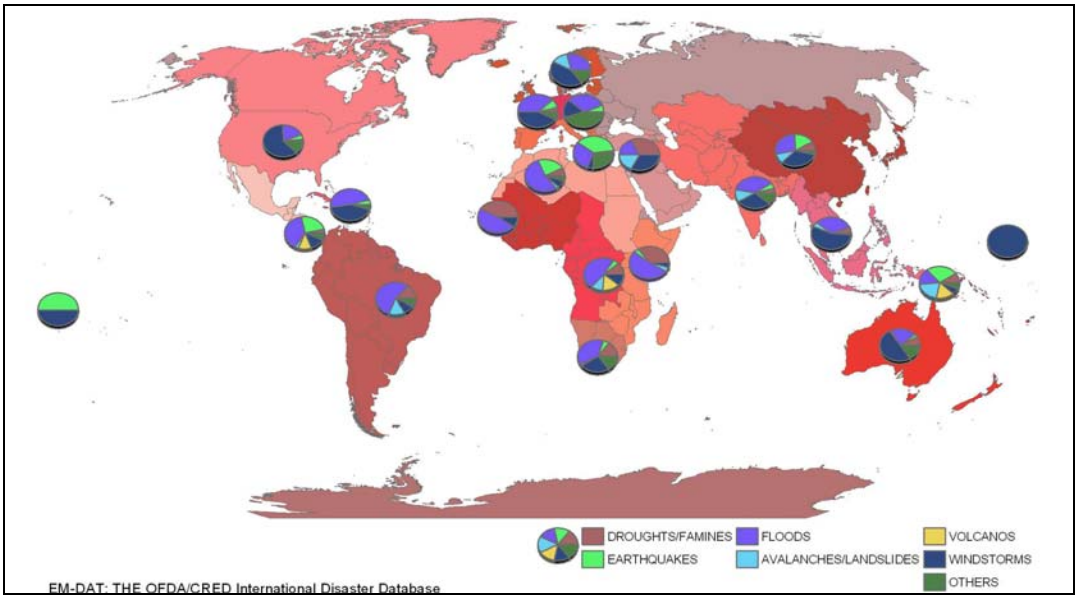

Figure 1: Disaster Type Proportions by United Nations Sub-Regions: 1974-2003
Source: EM-DAT: The OFDA/CRED International Disaster Database, www.em-dat.net, Université Catholique de Louvain, Brussels, Belgium

Just now, some of the worst flooding in over a decade is being reported across Nepal, India and Bangladesh as a result of summer monsoon rains. By the end of July, there have been over 285 fatalities in southern Asia since the flooding began, and up to 10 million people have been displaced by the extreme flooding.

1.2 Flood Disasters in Europe

In Europe, the number of disasters attributed to flooding is on the rise. Since 1998, over 100 major damaging floods have caused 700 fatalities, the displacement of about half a million people and at least € 25 billion in insured economic losses (EEA, 2003).

The assets at risk of flooding can be enormous. For example, more than 10 million people live in the areas at risk of extreme floods along the river Rhine, and the potential damage from floods amounts to € 165 billion. The total value of economic assets located within 500 metres of the European coastline, including beaches, agricultural land and industrial facilities, is currently estimated at € 500 to 1,000 billion (CEC, 2004).

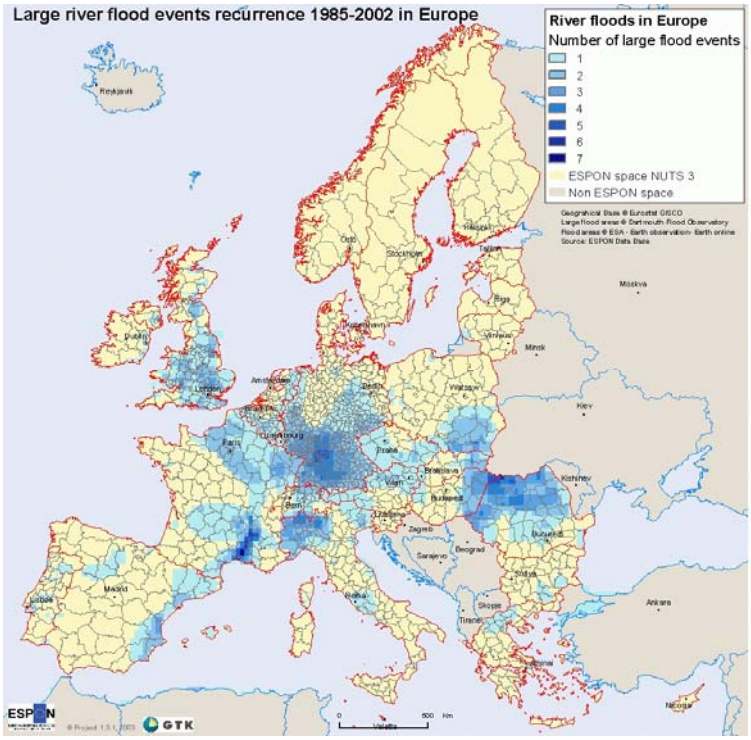

Figure 2: Large river floods in Europe 1985-2002
Source: ESPON Data Base

Figure 2 shows the large, discrete flood events in *Europe* during 1987-2002. Based on this map, which is mainly derived from remote sensing data, the highest amount of large flood events during this period is concentrated in North-Western Romania, South-Eastern France, the east of England as well as Central and Southern Germany.

Only during the past decade *Germany* experienced several great flood catastrophes (Rhine 1993 and 1995, Oder 1997 and 2001, Danube 1999 and 2001, Elbe 2002). In August 2002 Germany, but also the Czech Republic and Austria, were hit by the biggest flood disaster in

their history. The destruction caused by the extreme flood of the Elbe river and their tributaries was immense: 21 people died in the floods, tens of thousands had to be evacuated and thousands were made homeless. The overall damage is estimated to approx. 10 billion Euro for the entire territory of Germany and approx. 7 billion Euro for Saxony. There alone, 740 kilometres of roads and 180 bridges were destroyed.

In many places, the flood ruined all the reconstruction work that had been completed since the reunification of Germany fourteen years ago, destroying infrastructure, housing estates, business premises and historical buildings that had been restored at great cost.

Responding to the described floods the Federal Government encouraged several programmes to establish a preventive approach of flood protection (see chapter 3.2).

2. FLOOD PREVENTION AT INTERNATIONAL AND EUROPEAN LEVEL

2.1 Global Efforts

Based on the increasing frequency and magnitude of flood events worldwide, a lot of international organisations and activities have been initiated. Main objective of these projects is the development of new and improved methodologies to forecast, mitigate and prevent floods. Among others, the following institutions and initiatives are related to disaster research (including flood research) at global level:

- United Nations International Strategy for Disaster Reduction (ISDR), including the International Flood Network (IFN)
- the United Nations University Institute for Environment and Human Security (UNU-EHS), created on the 1st December 2003 in Bonn, Germany
- the UNESCO Centre for Water Hazard and Risk Management in Tsukuba, Japan

In addition to the implementation of case studies, priority was given to create comprehensive guidelines that could be used by governments, international (partly non-governmental) organisations and society to help avert losses from water-related disasters. The following key documents can be mentioned:

- the United Nations and Economic Commission for Europe “Guidelines on Sustainable Flood Protection” (UN/ECE, 2000)
- the UN/ECE document “Best practices on flood prevention, protection and mitigation” (UN/ECE, 2003)
- the UN Department of Economic and Social Affairs, Inter-Agency Secretariat of the International Strategy for Disaster Reduction, UN Economic and Social Commission for Asia and the Pacific “Guidelines for Reducing Flood Losses” (DESA, UN/ISDR, UNESCAP, 2004)

All documents aim to describe measures to reduce the risk of flooding on society, while all relevant aspects of water management, land-use, agriculture, transport and urban development at all levels (local, regional, national, international) are taken into account.

2.2 European Initiatives on Flood Prevention

Recent flood events in Europe, including the 1993 and 1995 events in the Rhine and Meuse basins, the summer floods of 1997 and 2002 in the Oder, Elbe and Danube basins and the UK floods of 2000/2001 have raised interest in measures of precautionary flood protection in an effort to reduce losses of life and property due to large floods.

The European Commission has financed research on floods in the framework of several environment research programmes. Research has concentrated on achieving a better understanding of causes and on methods of prediction and management of floods and their damage. Therefore, three main elements are of particular interest:

- water management,
- spatial planning and
- damage prevention/risk management

In order to prevent flood damage, these elements must be integrated into a new holistic policy and strategy.

Among other research projects on floods in the EU (e.g. EFFS, European Flood Forecasting System or FLOODRELIEF, Real Time Flood Decision Support System Integrating Hydrological, Meteorological and Remote Sensing Technologies) the transnational action programme IRMA, which stands for Interreg Rhine-Meuse Activities, launches a new policy of flood prevention based on spatial planning. During a six-year period (1997-2003), the concerned states Flanders, France, Germany, Luxembourg, the Netherlands and Wallonia jointly elaborated and implemented almost 153 projects inside the entire catchment area of the Meuse and Rhine (IRMA, 2003). All measures focus on the creation, restoration and preservation of (former) overflow areas/retention basins. In addition to these mostly structural measures, studies to develop the spatial planning instruments related to the reduction of high water and damage prevention is one of the main areas to be supported by the programme.

The project “Transnational conception for spatial planning of flood prevention in the Oder catchment area – ODERREGIO” (also funded by joint initiative Interreg II C of the European Commission) is another example of a concrete action programme for preventive flood protection.

Furthermore, the existing international river commissions (e.g. International Commission for the Protection of the Rhine, ICPR) can be mentioned, which develop joint strategies and projects involving aspects of spatial planning and land-use regulation.

A scope of duties of geodetic research could consist in an outstanding EU research activity: More concentrated research projects are needed to make use of recent technological advances in satellite, radar and aircraft measurement techniques for real-data rainfall collection. An optimal combination of these computer-based data with information on vegetative cover, soil information, land-use and flood plain delineation is needed for application in operational real-time forecasts and warnings and river basin models.

3. STRATEGIES AND INSTRUMENTS OF FLOOD PROTECTION IN GERMANY

3.1 Spatial Planning System in Germany

For a better understanding of the instruments of flood protection in Germany it is helpful to glance at the main features of spatial planning. Spatial planning in Germany relies on federalist and specialist co-operation instead of hierarchical and centralised decision-making. This is the reason why a comprehensive spatial planning programme does not exist for the whole federal territory (Federal Office for Building and Regional Planning, 2001).

The Federal Regional Planning Act (1998) formulates the principles and goals of spatial planning as well as guidelines such as sustainable spatial development. The federal Law contains a co-ordination between different planning levels, namely

- the Federal Government,
- the Laender,
- the municipalities and
- different types of spatially effective sector planning.

Concerning the federal Laender, the Federal Regional Planning Act aims at extensive planning programmes, but the Laender are able to define concrete design for their territories on their own. Within their regional plans, central places, main development and transportation axes are named as well as areas of supra-regional or federal interest become designated. They determine areas in which certain goals have priority, for instance nature and landscape conversion, local recreation, agriculture and also flood protection. The statement of regional plans are primarily meant to be specified in subregional plans for parts of the Laender but serve at the same time as binding statements for municipal planning (in form of preparatory land-use plans for the whole communal territory and more detailed legally binding land-use plans, see table 1).

On this basis the municipalities finally decide on concrete land-use within the framework of their planning competence.

State Structure	Level of Planning	Legal Foundation	Planning Instruments	Scale
Federation	Spatial planning at Federal Level	Federal Regional Planning Act		

State Structure	Level of Planning	Legal Foundation	Planning Instruments	Scale
Laender	State planning (Spatial Planning at Land Level)	State Planning Law (e.g. Spatial Planning Law of North Rhine-Westphalia)	Regional plan (for the territory of a land)	1 : 500.000 - 1 : 200.000
Region	Regional planning (for parts of the Länder)		Subregional plan	1 : 50.000 - 1 : 25.000
Municipalities	Local planning (Urban land-use planning, area development planning)	Federal Building Code	Preparatory land-use plan	1 : 10.000 - 1 : 5.000
			Legally binding land-use plan (local development plan)	1 : 2.500 - 1 : 1.000

Table 1: Spatial Planning System in Germany

You have to notice that Germany's spatial development cannot be viewed only on national scale. The member states of the European Union and the European Commission have been co-operating continuously in spatial planning affairs. Due to this fact, the afterwards described methods and instruments of flood protection have to be seen in an European context.

3.2 Spatial Planning as a Tool of Risk Prevention

In this chapter, the spatial planning instruments for preventive flood management in Germany are described. As a consequence of the enormous economic damage of recent floods in central European river basins (described in chapter 1.2) a change of paradigm in flood prevention is essential. There is a growing realisation that various flood mitigation measures – and not only structural measures such as dams and dikes – must be combined in an integrated approach to flood disaster management. A balance between structural and non-structural measures to manage floods is required, where the main focus is shifting from large structural solutions to non-structural approaches such as avoiding or stopping building development in flood plains. Thus risk reduction through spatial planning has to be strengthened (DKKV, 2004).

The concept of the (new) long term strategy for reducing flood damage is based on the following three objectives:

- Give the rivers more room
- Restrain floods decentralised

- Control housing development – reduce damage potential

Particularly, the motto “more room for rivers” has become the governing principle to reduce flooding.

3.2.1 Political Conditions in Germany

During the past years, the Federal Government has aimed the legislative regulations at the requirements for flood protection. The following regulations or recommendations are the most important ones:

- Laender Working Group on Water: Guidelines for Forward-Looking Integrated Flood Protection (LAWA, 1995)
- Standing Conference of Federal and State Ministers Responsible for Spatial Planning: Recommendations “Preventive Flood Protection by Spatial Planning” (MKRO, 2000)
- 5-Point Programme of the Federal Government (2002)
- Federal Government’s Law on Improvement of Preventive Flood Protection (2004)

In these resolutions and recommendations at federal level, the described paradigm shift is already implemented in the sense of new or revised objectives, basic principles, presentation and determination possibilities.

In March 2004, the Federal Government presented a special Federal law on flood protection, which is still in ratification process. The 5-Point Programme of the Federal Government, which passed in September 2002 after the flood disaster in the Elbe region, can be regarded as the basis of the draft of the “Law on Improvement of Preventive Flood Protection”. In this draft the key objective is to leave more room for rivers, particularly their natural flood plains, or to give the space back to them. Accordingly, measures for moving dikes further away from river banks and conservation or restoration of flood plains have to be included in the flood protection strategies. The law will also include certain restrictions on construction of buildings in areas classified as “at risk of flooding” and agricultural use in high-risk areas.

The draft envisages amendments in the Water Management Act, Federal Building Code, Federal Regional Planning Act, Federal Waterways Act and in the Law governing the German Weather Service.

3.2.2 Fields of Action for Spatial Planning

The various action possibilities to improve preventive flood protection can be described in a system of five fields of action (Heiland/Dapp, 2001). Long-term sustainable spatial planning based on “protection and extension of retention areas”, “retention in the catchment” and “minimisation of damage potential” (fields of action 1-4, confer table 2).

1	**Protection of existing retention areas** • declaration of flood areas	**Contribution of spatial planning and urban development**
2	**Extension of retention areas** • backward relocation of dikes • creating detention ponds • restoration of large streams • flood plain scrapes/deepening of retention areas	
3	**Retention in the catchment** • rainwater storage and greywater use • restriction of sealed surfaces • reduction of interflow on agricultural and forestry land • restoration of small streams	
4	**Minimisation of damage potential** • preventive land-use management • precautionary measures of construction • information of the public • improvement of public awareness • prediction of floods and warning • disaster prevention/control	
5	**Technical flood protection measures** • dikes • flood protection walls • retention ponds • river dams, barrages	

Table 2: Fields of action for preventive flood management
Source: IRMA-SPONGE project no. 5, executive summary, draft vers. 2 (modified)

As shown in table 2 flood risk can only effectively be reduced if, in addition to technical measures, spatial planning regulates land-use in flood-prone areas. Sustainable spatial planning based on promoting building development outside of the flood-prone area as often as possible, avoiding or stopping building development in flood plains (land-use control) and developing appropriate building codes or zoning ordinances to reduce flood damage. The best way to reduce the damages is to prevent development on flood-prone lands with appropriate instruments of spatial planning. Alternate use of flood-prone land should be considered where possible. It is better to have the land zoned and used for purposes such as parks, nature areas or ecological reserves than to try and ensure that future development is flood proofed.

These (mostly) non-structural measures comprise a variety of farming, cropping and cultivation techniques, the purposes of which are to maintain a protective vegetative cover and increase infiltration.

Removal of flood-prone development and conversion of the land to a conforming use may be more expensive in the long run than zoning flood-prone lands and relocate flood-prone development.

Precautionary and sustainable spatial planning efforts must concentrate on attaining an equilibrium between economic urban development and urbanisation on the one hand and the needs to allocate more space to water for water retention on the other hand.

3.2.3 Regulative Instruments of Spatial Planning

As already described, there is a very close connection between spatial planning, water management and risk mitigation (see table 3). Consequently, spatial flood protection measures are also part of spatial planning tasks. Article 2, section 2 of the Federal Regional Planning Act stipulates that preventive flood protection includes securing or re-allocating river meadows, water retention basins and flood-prone areas.

This guiding principle is to be implemented step-by-step at state level by their regional plans, at regional level by subregional plans and at a local authority level by local development plans (preparatory land-use plans and legally binding land-use plans, confer chapter 3.1).

Fields of Action	**Legal Foundations**	**Supra-regional and regional instruments**
Spatial Planning	Federal Regional Planning Act	• Declaration of flood risk areas as priority areas • Declaration of flood risk areas as reserve areas
Water Management	Water Management Act	• Determination of flood areas • Installation of flood action plans • Installation of regional flood concepts
Risk Management		• Flood forecasting • Implementation of early-warning systems • Development of flood hazard maps

Table 3: selective instruments of flood protection in Germany

After identifying immediate *flood risk areas*, there exist two instruments of the German planning system to designate them by law in the regional plans of the federal Laender (state and regional planning). *Priority areas* or sites (§ 7 Section 4 No. 1 Federal Regional Planning Act) can be designated in structural planning in case the local or regional situation requires that a particular function (e.g. recreation, nature/landscape, mining, urban expansion) shall have priority in that area. Any planning action must be compatible with this priority purpose. In contrast to this, *reserve areas* or sites (§ 7 Section 4 No. 2 Federal Regional Planning Act) can be designated in structural planning in case the local or regional situation requires that an area shall be reserved for a particular function (e.g. nature/landscape, mining, flood risk area).

As already mentioned for the first type of area, any planning action must be compatible with this priority purpose.

The *flood areas* determined by the federal states are another requirement to be observed within the urban land-use planning. In terms of water management, they are considered as the most important instrument for securing flood water retention areas. With the amendment of the Water Resources Act (1996) the objectives of the determination of the flood areas were concretised and their function as a natural retention area included in the regulation.

In contrast to flood areas, flood risk areas in terms of spatial planning contain flood-prone, not dike-protected areas as well as sites with existing building coverage (confer fig. 3). For exact delineation of a flood (risk) area, there is a need to select a "design" event. Therefor, a specific occurrence probability of a flood event have to be chosen (in Germany generally the 100-year-flood).

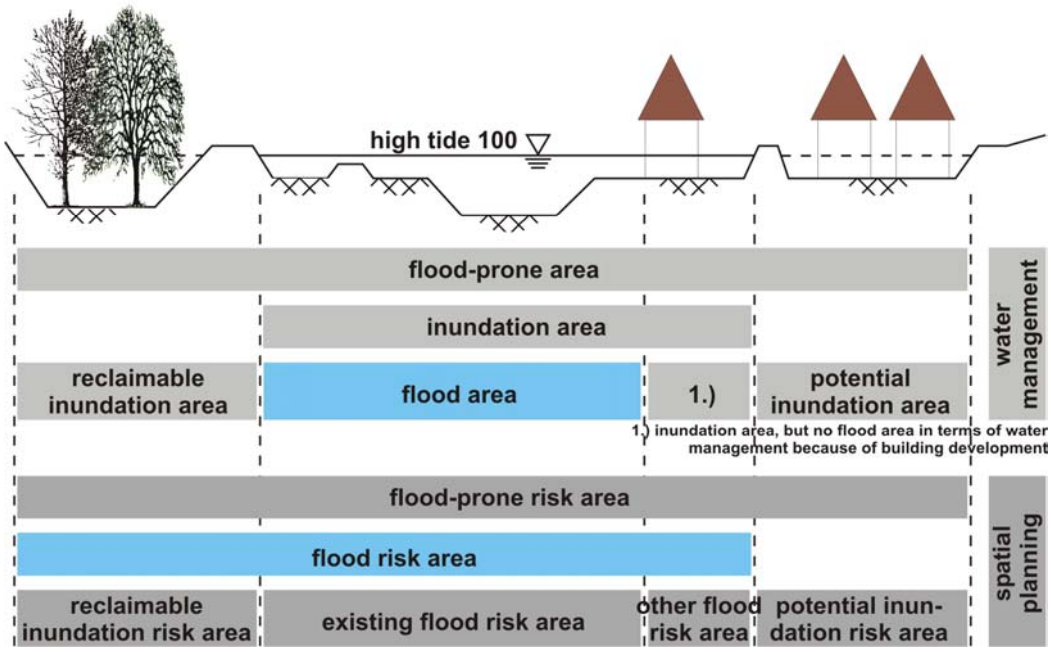

Figure 3: Overview concerning the different types of flood areas in Germany
Source: North Rhine-Westphalia State Environment Agency (LUA NRW), modified and translated

According to the instruments of water management, the *flood action plan* for the entire Rhine catchment area is a good example to provide interdisciplinary and cross-border flood protection. In 1998, the plan was adopted by the 12th Rhine Ministers' Conference (attended by Environment Ministers from France, Germany, Belgium, Luxembourg and the Netherlands) and contains a long-term strategy for reducing flood damage with the following four targets for action:

- reducing flood risks,
- reducing flood levels,
- intensifying awareness of flooding and
- improving flood reporting systems.

The action plan on floods is divided into implementation schedules to 2000, 2005 and 2020 (fixed by the International Commission for the Protection of the Rhine, ICPR) and is designed as a framework plan, whose contents have to be more specifically designed by an ongoing process.

There are large regional differences in the way spatial planning instruments are used to control urban development in potentially flooded areas. The proper use of spatial planning instruments, to ensure that fewer investments will take place in flood-prone areas, can be improved on the basis of risk zoning based on flood hazard maps as an effective tool for communicating spatial planning decisions to everyone involved (see chapter 3.2.5).

3.2.4 Instruments of Urban Land-Use Planning

At local authority level essential contributions to preventive flood management can be made by the instruments of land-use planning.

The preparatory land-use plan has active possibilities of demonstration as well as possibilities of indirect integration via "reporting" and "designation". The new instruments of the joint preparatory land-use plan (§ 204 Section 1 Federal Building Code) or the regional preparatory land-use plan (§ 9 Section 6 Federal Regional Planning Act) are potentially interesting – but hardly ever used – for inter-communal/ regional preventative flood protection.

With directives of the urban land-use planning there exist two possibilities. A direct contribution to flood control (e.g. determination of flood risk areas) just as (accompanying) indirect or preventative measures to minimising flood hazards (e.g. reforestation, avoidance of sealing). When drawing up legally binding land-use plans to realise the objectives of preventative flood management the local authorities can take advantage of various security instruments (development freeze, postponement of applications for building permit, right of pre-emption).
Furthermore, flood action plans, regional flood concepts, regional flood plain protection and water development concepts are as *informal super-ordinate plans* of indirect significance for local planning.

3.2.5 Mapping of Flood Danger

Hazard maps have been recognised as an instrument for disaster management in many countries in recent years. However, most of them are literally only maps indicating dangerous spots and not useful for practical applications of disaster reduction.

Flood risk mapping defines the area at risk and should be the basis for all flood damage reduction programmes. The maps often have a legal importance in terms of zoning and other structural and non-structural measures undertaken, so they need to be accurate and credible.

The mapping is normally based on a frequency of flood event determined by public consultation and reflected in policy, which may be based on a vulnerability analysis that is area specific. Zoning and flood proofing measures can be used to control urban development and reduce future flood damages, but the effectiveness of such measures is highly reliant on enforcement and maintenance.

Through modern computational systems, inundation maps can be generated in real-time and be part of the forecast and warning system. These can specially assist in communication to residents in areas of potential risk as well as in planning response actions and assistance. One of the most important criteria for the content and the depth of details of a flood hazard map is the scale. Table 3 shows three possible presentation forms of hazard maps at national, regional and local level.

	Overview map	**Hazard-index map**	**Hazard map**
Scale	1:100.000 – 1:100.000.000	1:10.000 – 1:100.000	1:2.000 – 1:10.000
Aim	Overview map on national or supra-regional level	Identify / localise the hazards Basis for regional planning Rough detection of conflict of interests	Analyse / assess the hazards Basis for local planning Basis for planning of precautionary measures
Content	Overview of threat to individual regions or municipalities	Overview of threat to individual parts of municipalities Maybe subdivision into several degrees of danger	Detailed information on type, extent and degree of hazards Detailed documentation is necessary
Accuracy	Very low	Low	High – plot sharp limitation
Target group	Spatial planning, policy	Regional Planning, water management, policy, reinsurance companies, society	Local land-use planning, local policy, insurance companies, emergency planning, affected population

Table 4: Mapping of flood danger on different scales
Source: IRMA-SPONGE project no. 5, executive summary, draft vers. 2

In recent years, fundamental endeavours in hazard zoning have been made in Germany. The German city of Cologne is amongst those which are at the highest risk of flooding in the country and had developed a plan for flood protection as early as 1995. In addition to measures for constructional flood protection, this plan includes measures to avert danger and civil disaster measures, together with measures in the fields of town planning and urban development.

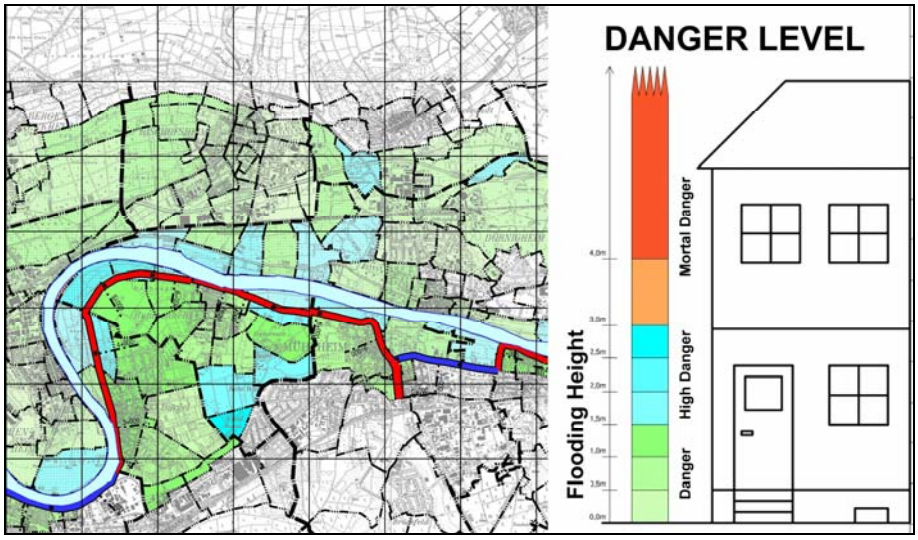

Figure 4: Flood hazard map for the river Main (Hesse/Germany) – excerpt form
Source: Regional Council Darmstadt
(http://www.rpda.de/dezernate/abflussverhaeltnisse/hochwassergefahrenkarten/index.htm)

Another good example is the flood hazard map for the river Main, which can be viewed online via the internet. The map in figure 4 shows the areas, which are flooded in extreme cases (200-year-flood event) for instance as a result of breakdown of dikes (fracture, overflow). In that case, medial flooding heights are indicated (see legend). The designation of the danger level gives an estimation of the risk based on the increasing flooding height.

Therefore the map distinguishes between areas, which are directly exposed to the water rise (open systems, light-coloured) and areas, which are protected by dikes and dams (closed systems, deep colouring).

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

As described in the article, flood protection is becoming more and more important. Experts assume that a rise in global temperature will intensify water circulation and may therefore increase the frequency and magnitude of flood events.

In order to be prepared for flood disasters in the future, interdisciplinary and precautionary measures with regard to water, risk and land management. In particular spatial planning with respect to agriculture, forestry, the protection of natural areas and the development of settlements play an important role in the process of flood plain management.

The various new German legislative regulations at all levels (in combination with the international and European activities) underline the urgent need of an effective flood protection system which is generally a mix of structural and non-structural measures.

In the field of flood disaster management, the area of application of a geodesist can be seen primarily in three groups of objects:

- Collection of flood-relevant data and flood monitoring by using different data sources such as remote sensing data, satellite data or radar data
- Development of digital elevation / terrain models (DEM/DTM) for the river basin as part of Geographic Information Systems (GIS) and other computer-based information systems
- Development of instruments for spatial planning to reduce flood damage, participation in design of flood hazard maps

Although the preliminary development of flood protection concepts has shown first results, much further work needs to be done.

4.2 Recommendations

The variety of spatial planning systems worldwide as well as the multitude of natural and socio-economic aspects of disaster reduction and response that differ from place to place make the formulation of general guidelines almost impossible.
In connection with preventive flood protection long-term sustainable spatial planning is needed, which mainly based on the following measures:

- Limitation of soil sealing in flood-prone urban and rural areas by implementing unsealing measures which promote rainwater infiltration
- Limitation or prohibition of agricultural land-use in flood areas which cause land erosion (by change of vegetation cover)
- Keep areas open: Avoidance or termination of building development in flood areas, if necessary removal of flood-prone development
- Determination of flood-related objectives, basic principles and flood protection measures in legislative regulations
- Flood (risk) mapping: Delineation of flood (risk) areas, presentation in maps
- Development of appropriate building codes, zoning ordinances or recommendations to reduce flood damage (flood proofing construction)

Because of the complexity of flood prevention, there is a strong need to cooperate between different administrative levels (international, national, regional, local) as well as various types of organisations (governmental, public, municipal, private) and disciplines (water management, land management, risk management).

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