Spatial planning and supporting instruments for preventive flood management



IRMA - SPONGE project no. 5

Executive summary

draft vers. 2

DARMSTADT UNIVERSITY OF TECHNOLOGY

Water Supply and Groundwater Protection
Wastewater Technology
Waste Management
Industrial Material Cycles
Environmental and Spatial Planning

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Environmental and Spatial Planning
Department of Civil Engineering

University of Berne, Switzerland

Department of Geography
Applied Geomorphology and Natural Risks

Darmstadt / Berne, December 2001

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This project is part-financed by the EU INTERREG II C programme IRMA
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and supporting instruments
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Abstract

The floods and the risk in the Rhine basin can only effectively be reduced if, in addition to technical measures, spatial planning regulates land use in flood prone areas. Furthermore future detention areas as well as room for river functions must be safeguarded in a long term perspective. In addition spatial planning can influence the conditions for the genesis of floods by changing the land use in the catchment, which however, has only small effects on the main flood disasters.

The research team from the universities of Darmstadt and Berne, supported by experts from the Netherlands and Switzerland, worked out suggestions for European, national, regional and local spatial planning authorities.

In regard to spatial planning two groups of instruments were investigated in Switzerland, France, Germany and the Netherlands:

- "zoning instruments" (regulative instruments of regional planning, hazard zoning) and
- supporting "soft" instruments (co-operation, incentives, information management).

The results are based on theoretical analysis and case studies:
In the framework of an interregional co-operation structure ("flood management alliance") the improved application of regulative instruments is recommended. Based on obligatory hazard maps graded for different planning levels, regional and local planning activities have to regulate the land use in flood prone and detention areas. An information management structure provides authorities and the public with necessary information to improve the integration of the needs of flood management into various fields of planning in an early stage.

Additional, financial compensation and burden sharing between downstream and upstream regions shall improve the acceptance and the realisation of detention measures. However, the local public is decisive for personal and institutional precaution. To raise public awareness information and integration of the local public have to be improved by adequate measures.

Keywords

spatial planning, regional planning, hazard zoning, flood management, interregional co-operation, burden sharing, information management, risk management, public awareness

Contents

1 Introduction 1
1.1 Background 1
1.2 Objectives 1
1.3 Methods 2
1.4 Research team and financing 3

2 Zoning instruments 4
2.1 Demands on spatial planning 4
2.1.1 Fields of action for spatial planning 4
2.1.2 Action areas in the Rhine basin 4
2.2 Regulative instruments of spatial planning 6
2.2.1 International comparison 6
2.2.2 Application practice in regional planning 7
2.3 Hazard zoning 8
2.3.1 Management of flood risks and spatial planning 8
2.3.2 Flood hazard mapping 8

3 Supporting instruments 11
3.1 Interregional co-operation in the Rhine basin 11
3.1.1 Existing interregional co-operations 11
3.1.2 Demands on additional interregional co-operation 11
3.1.3 Building up co-operation structure for spatial planning 12
3.2 Economic instruments 13
3.2.1 Financing of preventive flood management 13
3.2.2 Economic models for supporting spatial planning impulses 14
3.2.3 A burden compensation approach 14
3.3 Information management 15
3.3.1 Legal framework conditions 15
3.3.2 Information technologies 16
3.3.3 Information management structure - perspectives 16

4 Public awareness and emergency management 18
4.1 Flood awareness and flood damage 18
4.2 Information and communication at local level 18
4.3 Precautionary measures and self-reliance 18
4.4 Public emergency planning 19

5 Conclusions and recommendations 20
5.1 Conclusions 20
5.2 Recommendations 21

Figures

fig. 1: Case study areas and individual focus on the research topics 2
fig. 2: Fields of action of preventive flood management 4
fig. 3: Action areas and importance of the fields of action for regional planning 5
fig. 4: Spatial planning systems in the countries of the Rhine basin 6
fig. 5: Consideration of flood danger on medium- and small-scale maps 9
fig. 6: Consideration of flood danger on local level 10
fig. 7: Suggested co-operation structure 12
fig. 8: Co-operation levels 12
fig. 9: Distribution of IRMA-subsidy compared with the estimated expenses per country 13
fig. 10: Economic models for interregional financing of flood protection measures 14
fig. 11: Recommended information management structure for preventive flood management 17
fig. 12: Risk management diagram 19

Tables

tab. 1: Regional differentiation of the fields of action 5
tab. 2: Application practice in regional planning 7
tab. 3: New basic principles for flood risk policy in spatial planning 8
tab. 4: Mapping of flood danger on different scales 10
tab. 5: Examples of existing interregional co-operations 11
tab. 6: Financing of flood management measures in the countries along the Rhine 13
tab. 7: Calculation of the compensation offer from external benefits 14
tab. 8: Regulations on information management in planning law 15
tab. 9: Information management structure for preventive flood management 16

1 Introduction

1.1 Background

Along the Rhine River the potential damage value for extreme floods varies from some hundred million Euro per region in the upstream regions to more than 200 billion Euro in the Netherlands. The 1993 flood in the Rhine basin caused damage of about 2 billion Euro (mostly in Germany), the 1995 flood caused 11 billion Euro (mostly in the Netherlands).

These floods accelerated a change of paradigms in all countries in the Rhine basin: from believing in technical protection works and the conviction to be save behind dikes towards risk assessment, precautions and making way for rivers and floods. This philosophy is the basis for the current European politics. In 1998 the transnational working group "Spatial Planning and Preventive Flood Protection Rhine-Meuse" named as essential tasks:

- Examination, comparison and supplementation of national spatial planning instruments
- Safeguarding areas through spatial planning means in all plans and programs
- Inclusion of flood information in all plans and programs
- Safeguarding of retention areas for emergency flood events
- Differentiation of protection standards
- Creation of transnational spatial planning working levels (co-operation)
- Development of transnational co-financing models
- Compensations for burdens resulting from external benefits.

Various analyses in the past have shown that there are still considerable deficits in the realisation of the tasks named above. Thus the investigations in this project shall provide an international comparative, up-to-date overview of the attainment status of these goals and produce concrete proposals for making further progress.

1.2 Objectives

The main objective of this study is to work out suggestions for spatial planning authorities to support their efforts in regulating land use in regard to the criteria of preventive flood management.

In the sense of this project the criteria for future planning approaches aim on land use regulations to effect the genesis and the discharge of floods, to improve adapted land use in flood prone areas and to improve individual or local precautions.

Beside the planning instruments themselves, the framework of planning and decision making is decisive for land use development. Thus the investigations comprise

- "zoning instruments” (regulative instruments of regional planning, hazard zoning) and
- supporting "soft” instruments (co-operation, incentives, information management)
- public awareness and emergency management.

The study evaluates the actual efficiency of the instruments, examines the applications in theory and practice and makes suggestions for the improvement and for the integration.

1.3 Methods

The first phase of the project covered the assessment of

- relevant spatial plans, hazard maps and policy documents (more than 75),
- laws/regulations (spatial planning and water management, more than 50) and
- further information about the juridical framework and the practical application of planning instruments on regional level

in the countries along the river Rhine (Switzerland, France, Germany, the Netherlands).

On this basis in the second phase of the project hypotheses were established in regard to conclusions and recommendations. These were examined in depth in 16 case studies (see fig. 1) and reviewed on the basis of numerous interviews with experts from water-management as well as spatial planning authorities of the different levels.

Experts integrated into the project were from these major authorities:

National level:
Bundesumweltministerium (D), Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer (NL), Ministerie van Verkeer and Waterstaat (NL), Bundesamt für Wasser und Geologie (CH), Bundesamt für Bauwesen und Raumordnung (D), Rijkswaterstaat (NL)

Regional level along the Rhine:
Kantonale Fachstellen (CH), Direction régionale de l'environnement (F), Préfectures (F), Landesumweltministerien and Regierungsbezirke (D), Provincies (NL), Watershappen (NL).

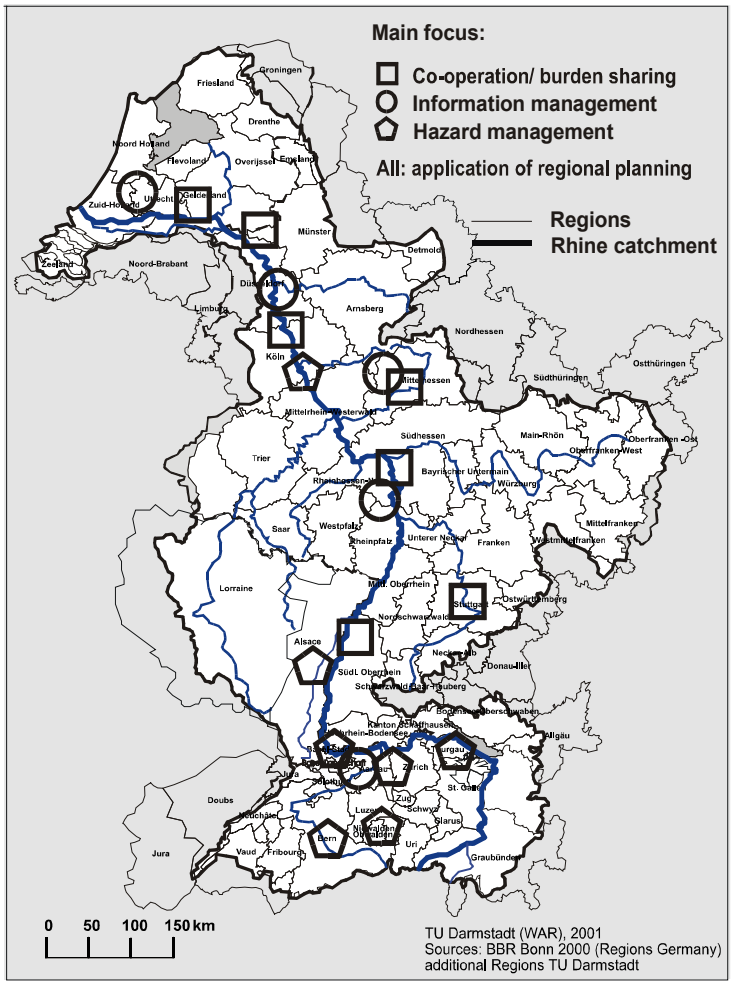


fig. 1: Case study areas and individual focus on the research topics

An expert workshop in Darmstadt was carried out in May 2001 to discuss the findings with 30 experts from water management and spatial planning authorities.

A permanent scientific exchange took place with relevant SPONGE participants. Especially the IRMA-SPONGE cluster "Spatial planning and Flood risk management at River Basin Level" was helpful to discuss the conclusions and recommendations with interdisciplinary and transnational experts.

1.4 Research team and financing

The research project was carried out within the framework of the INTERREG II C program IRMA-SPONGE in co-operation with numerous European research institutions, co-ordinated by the Netherlands Centre for Riverstudies (NCR). The basic research team was composed of:

- **Darmstadt University of Technology**, Germany (working group of Prof. Böhm) (regulative instruments, international comparison, co-operation, information management, economical instruments) - project leader.
- **University of Berne**, Switzerland (working group of Prof. Kienholz) (hazard zoning and hazard management, public awareness, spatial planning in Switzerland and France).

This project was supported by

- WL|Delft Hydraulics (Elma Ouwendijk) with regard to questions of spatial planning and water management in the Netherlands. The results provided relate to the report "Detention reservoirs and spatial planning instruments as used for flood prevention in Germany and the Netherlands" (2001, Delft).
- ETH Zurich (Wolfgang Ruf; Swiss Federal Institute of Technology, Institute of Hydromechanics and Water Resources Management Zurich) co-operation with the IRMA-ICPR-Project 3/DU/3/052 "Erfassung und Bewertung von Hochwassergefahren und –risiken": with regard to the damage data analysis in the "public awareness" section and with common case studies in Switzerland.

Furthermore, co-operation took place with other SPONGE participants on various subjects by exchanging findings and mutual preparatory work for each other (projects SPONGE no. 3, 4, 10 and 13).

This project is part financed by the EU Interreg II C programme IRMA within the SPONGE-project (no. 3/NL123/164) and co-financed by Darmstadt University of Technology, University of Berne and the Swiss Federal Office for Education and Science (no. 00.0174).

2 Zoning instruments

2.1 Demands on spatial planning

2.1.1 Fields of action for spatial planning

A system of five fields of action describes the various action possibilities to improve preventive flood protection (see fig. 2). The focuses of spatial planning are the fields of action "protection and extension of retention areas", "retention in the catchment" and "minimisation of damage potential" (fields of action A – D).

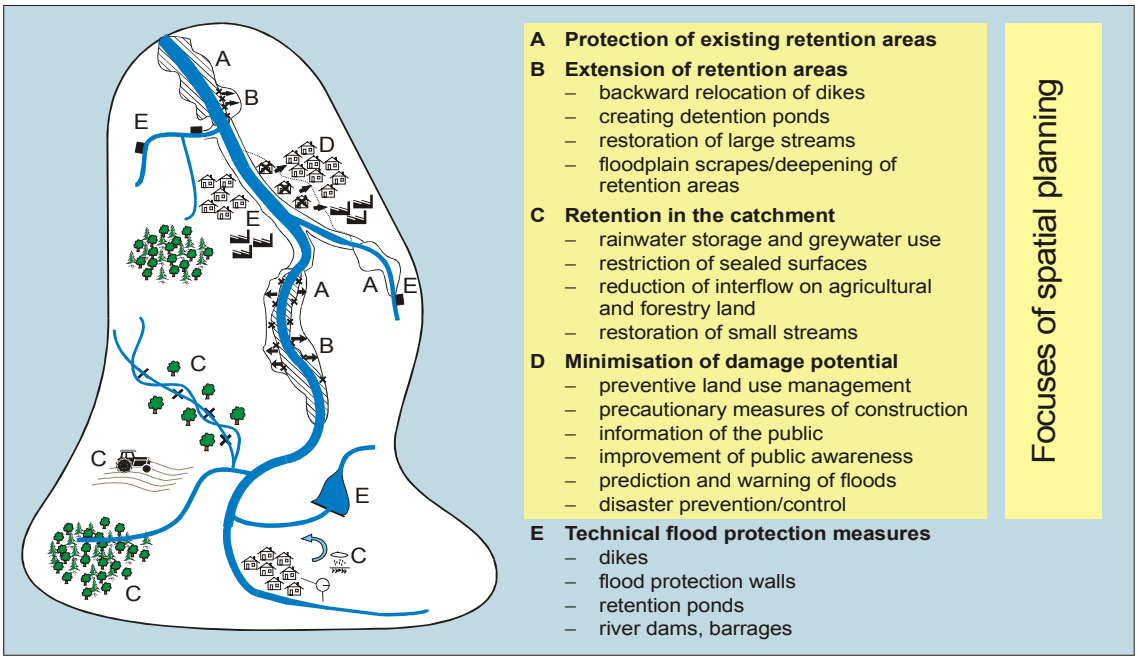


fig. 2: Fields of action of preventive flood management

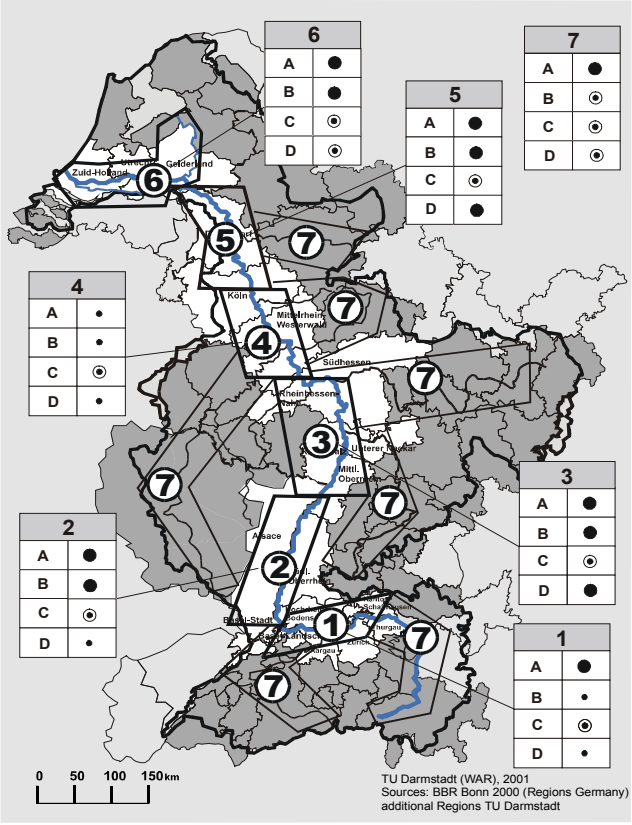
The regional level of spatial planning plays a decisive role in the precautionary safeguarding of areas and in the control of land use over larger areas (fields of action A, B and C). However, for the control of local measures for retention of water (e.g. rain water management and restoration of natural streams) and for minimising of damage potential (field of action D) the municipal planning level can make the more effective contribution (see chapter 4).

2.1.2 Action areas in the Rhine basin

For spatial planning, the importance of the fields of action A – D (fig. 2) varies according to the specific conditions in each area of the Rhine basin. Action areas in which the individual fields of action are of similar importance, can be identified according to the following criteria:

- Prevailing flood danger
- Morphological and orographical situation
- Possible effects of retention measures.

The identified action areas and the importance of the fields of action for spatial planning at the regional level are shown in fig. 3 and substantiated in tab. 1.



Legend:

①-⑦ Action areas (see table 1)

A - D Fields of action

- **A:** Protection of existing retention areas
- **B:** Extention of retention areas
- **C:** Retention in the catchment
- **D:** Minimisation of damage potential

Importance for regional planning

- ● high importance
- ⊙ medium importance
- • low importance

fig. 3: Action areas and importance of the fields of action for regional planning

tab. 1: Regional differentiation of the fields of action

Action area		Importance of fields of action for regional planning			
		A: Protection of retention areas	**B:** Extension of retention areas	**C:** Retention in the catchment	**D:** Minimisation of damage potential
1	Lake Constance to Basel	**Preservation of retention volume of Lake Constance**	*Inferior action potential, since only useful downstream of alpine border lakes, where space is very restricted*	Local effects of this field of action, thus concerning mainly tributaries, added up effects also for major bed	*No essential problems because of river regulation and given morphology*
2	Basel to Iffezheim	**Flood plains** **Detention ponds**	**New detention ponds**		*No essential problems because of river regulation*
3	Iffezheim to Bingen	**Flood plains** **Detention ponds**	**Backward relocation of dikes** **New detention ponds**		**Land use management behind dikes**
4	Bingen to Bonn	*No flood plains exist because of given morphology*	*No room for creating retention areas because of given morphology*		*Flood endangering, only local flood protection, focusing precautionary measures of construction*
5	Bonn to Arnhem	**Flood plains** **Detention ponds**	**Backward relocation of dikes** **New detention ponds**		**Land use management behind dikes**
6	Rhinedelta	**Flood plains**	**Flood plain scrapes** **Backward relocation of dikes** **New detention ponds**	Effects for polder water management	Land use management between winter dikes
7	main tributaries	**Flood plains** **Detention ponds**	New detention ponds	Local effects, thus concerning mainly tributaries, added up effects also for major bed	Land use management
8	remaining catchment	*Retention reservoirs for local protection*	*New retention reservoirs for local protection*		*Local land use management necessary*

Legend:

high importance:	**dark grey shading, bold lettering**
medium importance:	light grey shading
low importance:	*no shading, italic lettering*

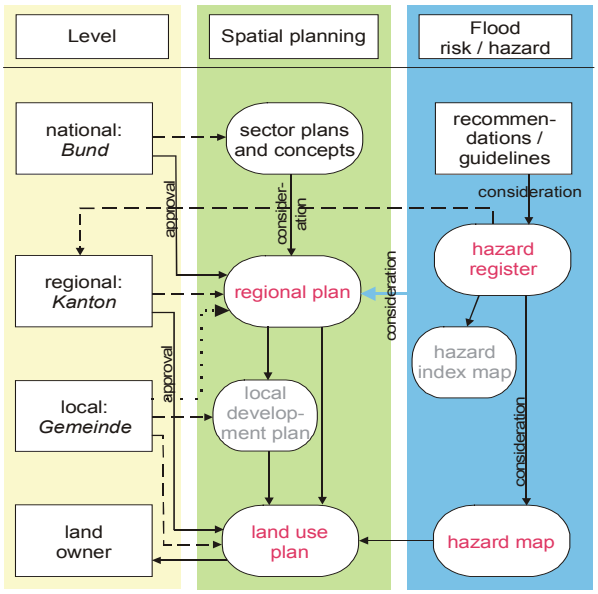
Note: The importance is evaluated in regard to the transregional impact of the different actions and in relation to other actions. However all actions may be of high importance for local preventive flood management.

2.2 Regulative instruments of spatial planning

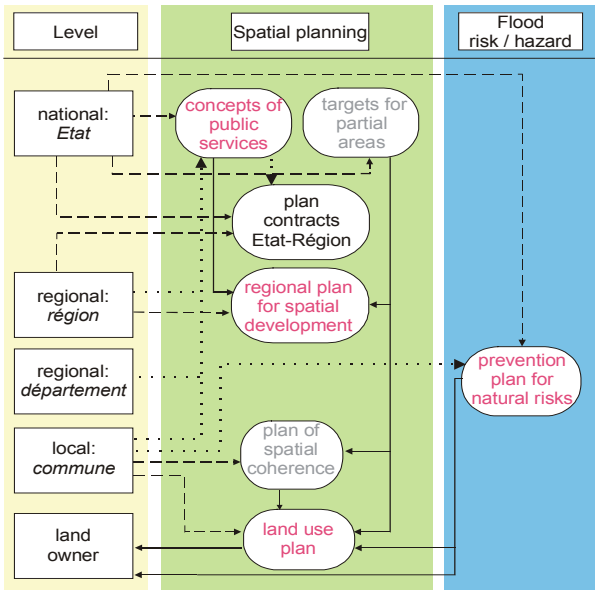
2.2.1 International comparison

At the regional level, important instruments for area-wide land use control are available in Switzerland (*Kanton*), Germany (*Land/Region*) and the Netherlands (*provincie*). In France, the responsibility lies with the central state authorities. As shown in fig. 4 the integration of flood hazards and risks into spatial planning is managed differently in each country of the Rhine basin. In German regional plans the use of priority and reserve zones for flood prevention allows for differentiated restrictions and recommendations for the local planning level.

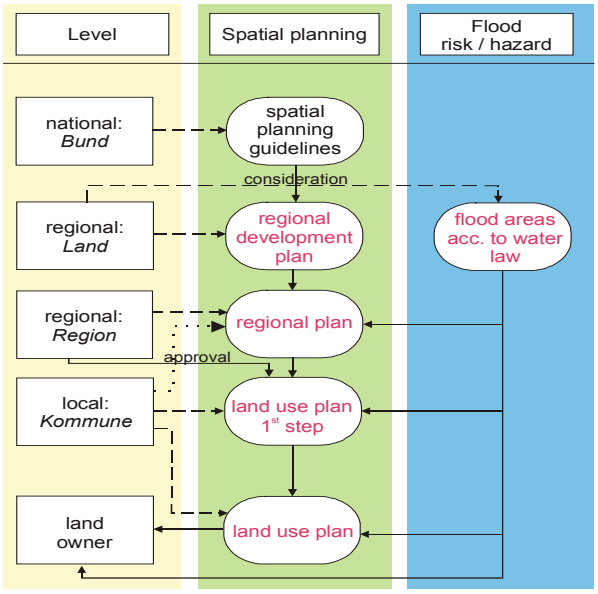
Switzerland



France



Germany



The Netherlands

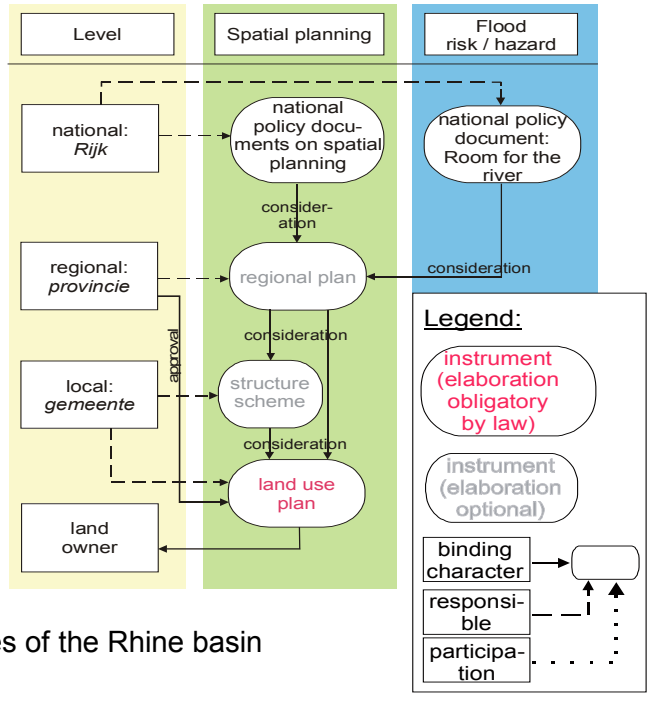


fig. 4: Spatial planning systems in the countries of the Rhine basin

2.2.2 Application practice in regional planning

The widespread evaluation comprised spatial plans at the regional level throughout the Rhine basin. The results are summed up in tab. 2.

tab. 2: Application practice in regional planning

	Consideration of fields of action (see fig. 2) in regional spatial plans			
	A Protection of retention areas	**B** Extension of retention areas	**C** Retention in the catchment	**D** Minimisation of damage potential
Swiss regional plans action areas: 1 + 7 (see fig. 3)	Yes Indirect preservation through the meadow land protection decree	None	None	Yes Targets for hazard maps, occasionally exist concrete area references in the map
Alsacian contribution to French "National concept for natural and rural areas" action areas: 2 + (3)	(Yes) Target "protection of existing flooding areas" included in the text, no demarcation of concrete areas on map	(Yes) Only possibility of extension areas mentioned, no demarcation of concrete areas on map	None	Yes Along tributaries
German regional plans action areas: 2, 3, 4, 5 + 7	Yes Main focus on stipulating targets and defining priority zones for areas already safeguarded by water law	Yes Main focus on stipulating targets in the text without showing the exact area	(Yes) Stipulating targets without showing the exact area	(Yes) Occasionally targets for reducing the damage potential behind dikes with demarcation on map
Dutch regional plans action areas: (5) + 6	Yes Flood plains are protected as "nature conservation and nature development" areas	None	None	None

There are large differences between the contents of the individual regional plans. The given possibilities to contribute to preventive flood management are only used to a small degree. As shown in tab. 2 in the regional plans mainly the "protection of existing retention areas" and to a minor extent the "minimising the damage potential" are considered and regulated. Only to a very small degree the instruments are used to effect the "extension of retention areas" and the "retention in the catchment".

In the regional plans of regions along the Rhine different focuses are set on the individual fields of action. Predominantly these do not correspond adequately to the demands of the individual action areas (see tab. 2) but rather derive from the differences between the national planning systems and cultures.

2.3 Hazard zoning

2.3.1 Management of flood risks and spatial planning

Risk management is a method for the creation, development and control of systems for risk reduction. The risk at a certain place depends on the size (damage potential) and probability (occurrence and extent of a dangerous process) of the possible damage (see fig. 12, chapter 4). Hazard zoning, as a part of risk management, defines endangered areas independently from the potential damage.

Using a risk management system, decisions within society can be influenced regarding whether and how certain areas may be used. This is the central task of spatial planning which must therefore play the leading role here. In recent years, fundamental considerations with regard to the flood hazard such as the provision of more "room for the river‘‘, or the adaptation of land use – within the scope of preventive protection – led to new guiding models, guidelines and even to new laws within the catchment area of the Rhine (see tab. 3 and chapter 2.2).

tab. 3: New basic principles for flood risk policy in spatial planning

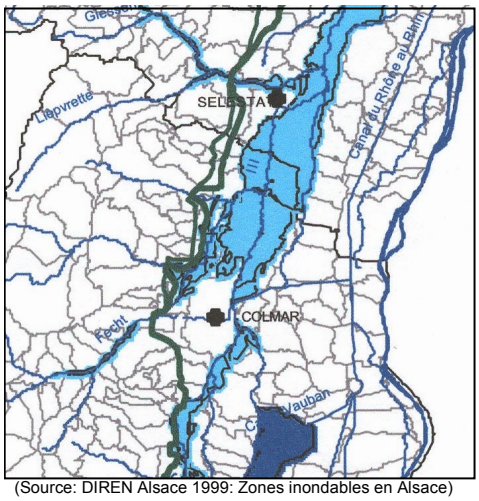
UN	Guidelines for sustainable flood prevention, 2000
EU	INTERREG IIC IRMA, 1997 – 2001
ICPR	Action plan on flood defence on the river Rhine, 1998
Switzerland	Federal law on flood protection, 1993 Recommendation "Consideration of flood hazard in land-use practice", 1997
France	Foreseeable natural risk prevention plan (PPR), 1995
Germany	"Guidelines for forward-looking flood protection" (LAWA), 1995 Recommendations "Preventive flood protection by spatial planning” (MKRO), 2000
The Netherlands	Room for rivers program, 1996 Fourth national policy document on water management government decision, 1998

2.3.2 Flood hazard mapping

Spatial planning must be enabled to take into account the flood danger when making land use decisions. Therefore, information about where these endangered areas are situated is required. In the Rhine basin a legal basis exists for the elaboration of hazard maps in France and Switzerland and, being not part of the investigated area, in Liechtenstein and Austria. In Germany and the Netherlands, this basis is lacking. Nevertheless, mainly in the German regions several projects with different approaches to flood hazard mapping can be found. Because of the topographical conditions hazard maps are not as suitable for most of the Dutch regions. More than half the population of the Netherlands live either below sea level or below the medium average height of the local river.

The most important criteria for the content and the depth of details of a map concerning flood hazard is the scale. As tab. 4 shows, the scale reaches from 1:2.000 up to 1:1.000.000. Fig. 5 provides examples of possible presentation forms of the flooding hazard at regional and supra-regional level. The Alsacian map (F) can be classified as an overview map, the remaining three as hazard-index maps (see tab. 4).

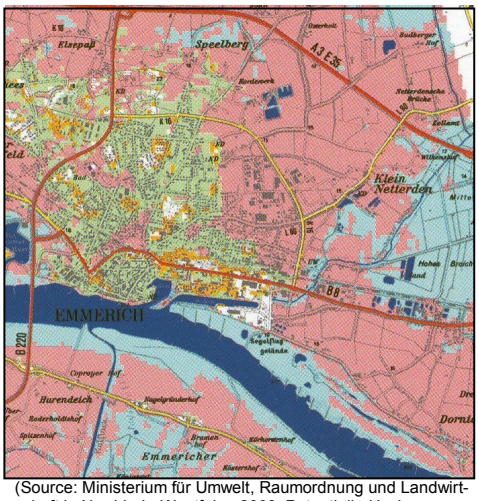
Inventory map of floodable areas
Alsace (F), 1999: 1:750.000



(Source: DIREN Alsace 1999: Zones inondables en Alsace)

- Floodable areas
- Possible floodable areas in case of dike failure in the Haute-Rhine region
- Limit of the alluviums along the border of the Rhine valley
- Limit of the main aquifer in the Rhine valley

Flooding-area map
Northrhine-Westphalia (D), 1999: 1:100.000

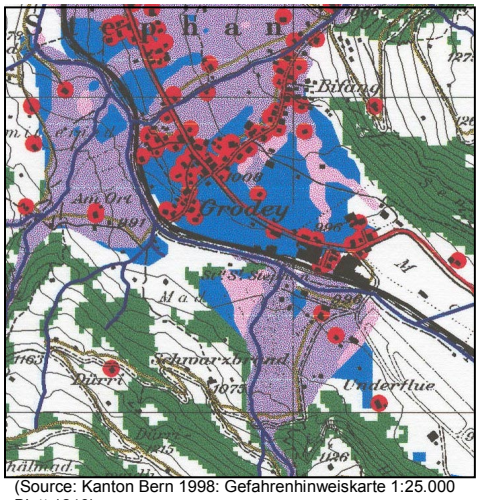


(Source: Ministerium für Umwelt, Raumordnung und Landwirtschaft in Nordrhein-Westfalen 2000: Potentielle Hochwasserschäden am Rhein in NRW)

Water depth in centimetre:

- Over 400
- 201 – 400
- 51 – 200
- 0 – 50
- Waters

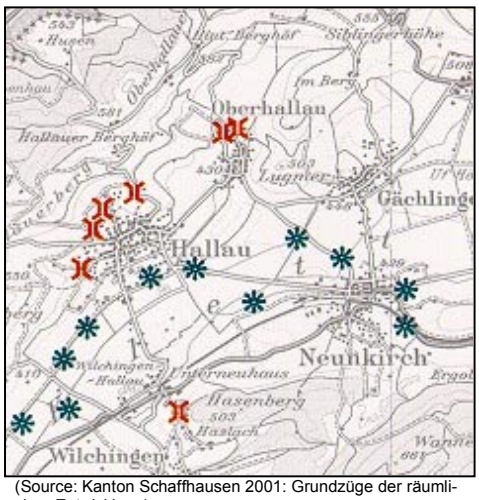
Hazard-risk-index map*
Canton of Berne (CH), 1998: 1:25.000



(Source: Kanton Bern 1998: Gefahrenhinweiskarte 1:25.000 Blatt 1246)

- Danger area
- Threat to buildings, roads or railways
- Danger of flood and fluvial sedimentation
- Buildings (permanently inhabited)

Regional plan, sheet “natural hazards”*
Canton of Schaffhausen (CH), 2001: 1:100.000



(Source: Kanton Schaffhausen 2001: Grundzüge der räumlichen Entwicklung)

- Area with flood danger
- Existing cover (danger of blockage)

*: Reproduced with approval of the Swiss Federal Office of Topography (BA013753)

fig. 5: Consideration of flood danger on medium- and small-scale maps

These examples show that due to the large differences in the hazard scenarios in the individual regions, a uniform presentation form for hazard information maps in the whole Rhine basin is of little practical value. It is much more important that the map takes account of the individual hazard situation of the region in question.

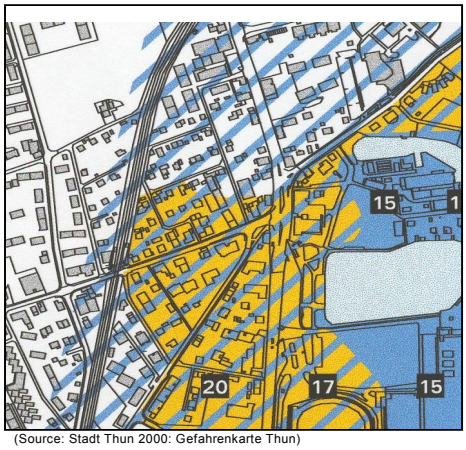
tab. 4: Mapping of flood danger on different scales

	Overview map	**Hazard-index map**	**Hazard map**
Scale	1:100.000 – 1.000.000	1:10.000 – 1:100.000	1:2.000 – 1.10.000
Aim	Overview map on national or supraregional level	Identify / localize 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

Maps as shown in fig. 5, however, are not adequate for the enforcement of use restrictions or prohibition on particular plots at the local level. Here, large-scale hazard maps (1:2.000 – 1:10.000) are necessary.

One example is the hazard map of Thun (CH) (see fig. 6), which was made according to the recommendations of the Swiss federal authorities. The second map shows the realisation of a prevention plan for natural risks (*plans de prévention des risques naturels prévisible, PPR*) in the zone plan of Illfurth (Alsace, F) according to the guidelines of the French Ministry of the Environment (*Ministère de l'aménagement du territoire et de l'environnement*).

Hazard map of Thun (CH), 2000: 1:10.000



(Source: Stadt Thun 2000: Gefahrenkarte Thun)

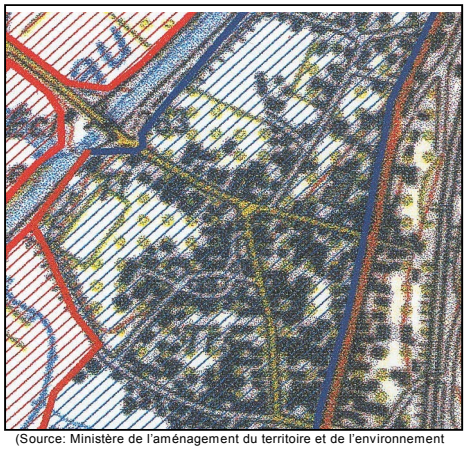
Medium danger

Low danger

During periods with high lake-level, groundwater-table can reach at least cellar

Waters

Land-use plan of Illfurth (F), 1998: 1:10.000



(Source: Ministère de l'aménagement du territoire et de l'environnement 1999: Plans de prévention des risques naturels – Risques d'inondation)

Zones with building ban

Zones with potential use for building under certain conditions

fig. 6: Consideration of flood danger on local level

3 Supporting instruments

3.1 Interregional co-operation in the Rhine basin

3.1.1 Existing interregional co-operations

Various co-operation forms have developed within the catchment area of the Rhine (see tab. 5). They often have no relationship to spatial planning instruments and thus do not have any effect on the actual land use, or they do have a spatial planning component but do not have any relationship with the subject of flooding. Exceptions are the IRMA programme itself and national working groups.

tab. 5: Examples of existing interregional co-operations

<table>
<tr><th colspan="2">Transnational</th><th colspan="2">National</th></tr>
<tr><th>Focus on spatial planning</th><th>Focus on water management and flood protection</th><th>Focus on spatial planning</th><th>Focus on water management and flood protection</th></tr>
<tr><td colspan="2">• IRMA-programme area</td><td colspan="2"></td></tr>
<tr><td>• EUREGIOS
• Transnational Working group spatial planning and flood protection
• Commissions on transnational co-ordination of spatial regional planning
• Transnational co-ordination of informal regional planning</td><td>• ICPR
• Common working group "Flood protection", Northrhine Westfalia - Gelderland
• Standing commission on border-crossing waters
• Different project working groups (Hydrology, Flood forecast etc.)</td><td>• Common regional planning committees
• Regional / transregional planning conferences
• Regional Agenda / other regional networks</td><td>• Länderarbeitsgemeinschaft Wasser LAWA (D)
• Working group of RWS / RIZA (NL)
• Working groups on special projects or measures</td></tr>
<tr><td colspan="2"></td><td colspan="2">• Working group of the ministry conference (MKRO, D)
• Working groups for the implementation of national strategies (i.e. Delta plan, RvR; NL)</td></tr>
</table>

3.1.2 Demands on additional interregional co-operation

As a framework for all activities the action plan on flood defence of the ICPR is a transnational agreement on targets for flood defence along the Rhine. But the regional and local concretisation as well as local acceptance is considered still inadequate. In opposite to water management networks, the regional spatial planning authorities work more separated in a less co-ordinated manner. Common tasks are:

- a concrete interregional spatial planning action program for all fields of action (chapter 2)
- creation of incentives to speed up the realisation of detention facilities (chapter 3.2)
- information management (chapter 3.3)
- common approaches in hazard management and public information (chapter 2.3 and 4).

The transnational and national level provides perspectives but is not suitable for the concrete realisation. The local level is responsible for small areas and is therefore not suitable for catchment wide approaches. In between the regional level could serve as the keystones of spatial planning co-operation:

- The Netherlands: the *Provincies* (4 along the Rhine branches)
- Germany: the administrative districts within the *Länder* (*Regierungsbezirke*, 10)
- France: the *régions* (1)
- Switzerland: the *Kantone* (5).

3.1.3 Building up co-operation structure for spatial planning

The co-operation structure is based on three levels (see fig. 7 and 8). Basic partners are regional spatial planning authorities. Occasionally other actors have to be consulted:

- Regional water administrations
- Other expert regional administration bodies (such as nature conservation or waterways)
- Superposed spatial planning authorities
- Existing co-operations and non-government organisations (NGOs)
- Municipalities.

The co-operation structure developed foresees the foundation of a union based on a contract. Tasks, financing, structure and a working program shall be designated. A central office as well as regular meetings of the participating groups and representatives of the regions are necessary. The concept envisages an overall working group, as well as areal and expert subject clusters and a central co-operation management office.

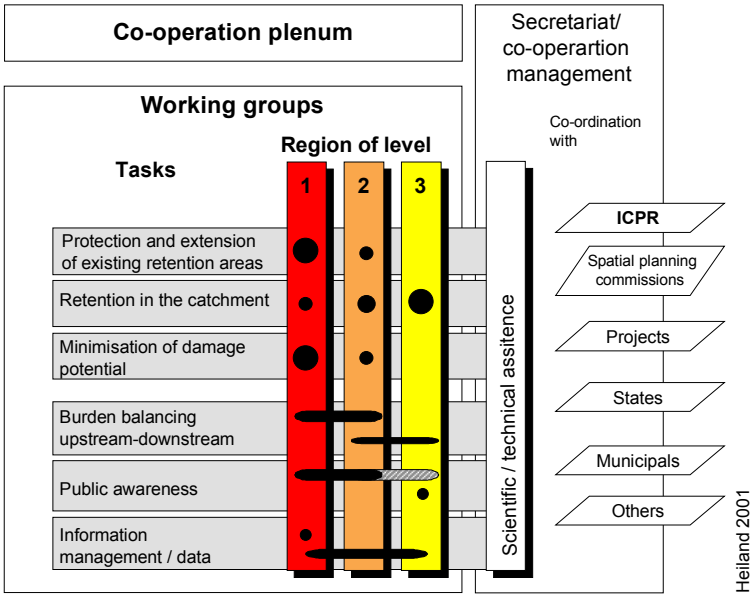


fig. 7: Suggested co-operation structure

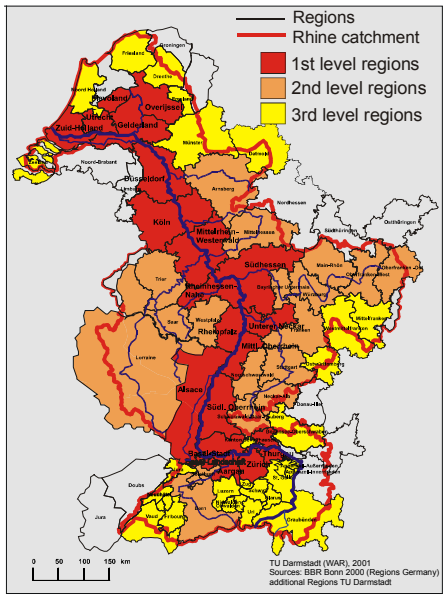


fig. 8: Co-operation levels

Examples show that to enhance the chance of co-operations it is necessary to

- set up a co-operation management and a central operating management office
- preserve a full acting autonomy of the co-operation structure
- avoid large differences in negotiating strength between the partners
- make the same information to all actors within the co-operation available
- keep a natural succession of co-operation steps.

Usually, at the start of a co-operation (initial phase, first 1-2 years) there is a high degree of attention. The development phase which then follows is characterised either by the formation of networks and the begin of constructive co-operation. A joint agreement on long term targets and tasks is important at this time.

3.2 Economic instruments

3.2.1 Financing of preventive flood management

The financing of flood management measures is regulated in different ways among the countries in the Rhine catchment area (see tab. 6).

tab. 6: Financing of flood management measures in the countries along the Rhine

	Financing	Contributions
Switzerland	National / *Bund* + Cantons + Municipalities	*Bund* (depending on financial situation of the Canton): • Constructions: 0 to 45 % • Hazard maps: 0 to 70 % Contributions by Canton and Municipality depend on stream classifications, measures and individual (economical) circumstances
Germany	*Bundesländer* (Large streams) Municipalities (Smaller streams) or "Dike-Union"	Usually only the responsible. • In special cases contributions by the *Bundesland* at small streams. • Often compensation for burdens possible: contribution by municipalities that have advantages.
France	Municipalities Private (if advantages)	Municipalities build and finance flood protection works • If necessary, the State gives financial support.
The Netherlands	Provinces *Waterschappen*	• Construction of dikes, re-naturalisation etc. by Provinces • Maintenance by the *Waterschappen*
European Union	Interreg II C (IRMA) (in future Interreg III, without special fund for flood protection)	• Subsidy (not Switzerland) • Max. 50 % (Studies, planning) • Min. 25 % (Infrastructure) • Mean about 35 %

Transnational financing in the IRMA program offers more than 80 % of all funding to regions in the lowland valley (NRW, Netherlands). The evaluation of the estimated expenses and approaches like the "causer pays" principle make clear that in future, in the interests of all actors, larger proportions of funding must go to the central and upper valley regions (fig. 9).

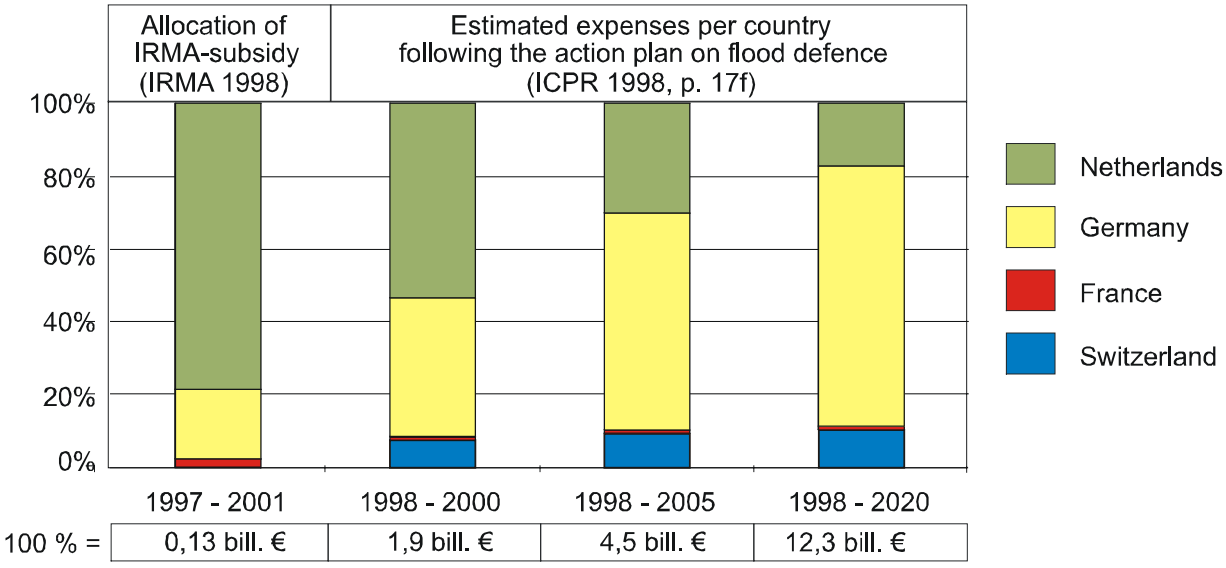
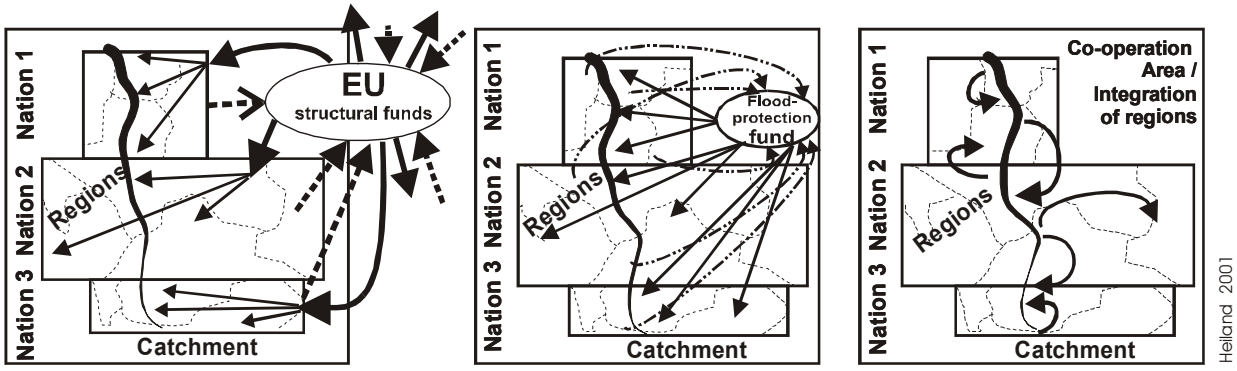


fig. 9: Distribution of IRMA-subsidy compared with the estimated expenses per country

3.2.2 Economic models for supporting spatial planning impulses

Currently, hardly suitable approaches for linking up spatial and economic instruments exist. For trans-regional financing of flood management and protection measures three possible basic models have been compared. They are shown very simplified in fig. 10:



National - regional - financing
- Regional responsiblity for financing
- Contribution by EU (fixed national rates)
- Transfer of money within countries
- Distribution of EU-subsidy doesn´t follow directly effects of measures or action plans

Flood protection fund
- Central distribution of funds throughout the catchment
- Payment connected with action plan
- Subsidy follows effects of measures
- Funds payed in by regions (causer, benefitter, subsidies)

Results of negotiations
- Common financing with downstream partners (who have benefits)
- Compensation for burdens upstream-downstream
- action plan/ framework for realizing measures necessary

fig. 10: Economic models for interregional financing of flood protection measures

3.2.3 A burden compensation approach

A suitable approach must be a mix of these models. The approach conceived here foresees the determination of the benefits and burdens in monetary terms and making a "compensation offer" with the "excess benefit" as the burden compensation. The calculation of the compensation offer follows the principle:

$$\textbf{compensation offer} = \textbf{benefits}_{\text{extern}} - \textbf{costs}_{\text{extern}} - \textbf{benefits}_{\text{intern}}$$

Individually, the following components can be monetarised according to the usual current practice and therefore they can be used for a corresponding calculation (tab. 7).

tab. 7: Calculation of the compensation offer from external benefits

Benefits for downstream actors (= extern benefits)	
+	• Reduction of the damage potential (municipalities / private / companies / agriculture) • Saved costs for maintenance (dikes e.g.)
Costs for the measure at the place of construction (= external burden)	
−	• Acquisition of land • Costs for planning and constructions • Landscape and renaturalisation • Compensation for farmers or affected infrastructure
Indirect benefits at the place of the construction (if possible for calculation) (= intern benefit)	
−	• Revitalisation of meadow lands • Improvement of the tourism and recreation qualities / Promotion for regions
= (result:) Compensation offer of downstream region and responsibles to affect local actors (if positive)	

This approach is based on the presumption that an integration area (see chapter 3.1) has been developed, negotiations and financial transfers are legally possible and that a consensus about necessary measures has been reached. Transaction costs must be kept low.

3.3 Information management

Information is the basis for every planning activity. For this reason, acquiring, processing, distributing and presenting information, i.e. information management, is a prerequisite for preventive flood management. It is in particular based on

- legal framework,
- structural conditions, and
- information technologies for its realisation.

3.3.1 Legal framework conditions

Planning laws, contain regulations concerning obligations of authorities in connection with information management (see tab. 8).

tab. 8: Regulations on information management in planning law

Level	Legal regulations of spatial planning law										Legal regulations of water management									
	Publicity			Information-exchange				Collection		Plan	Publicity			Information-exchange				Collection		Plan
	Information	Hearing	Integration	singular internal	singular external	internal	external	singular	continuous	min. contents	Information	Hearing	Integration	singular internal	singular external	internal	external	singular	continuous	min. contents
EU+											●	●		●	●			●		●
CH-national	●	●		●	●	●	●	●	●	●	●					●	●		●	
CH-regional	●	●		●	●	●	●	●	●	●	O			●	O	●			●	●
CH-local	●	●		●	●			●		●	O	O		O	O			O		O
D-national						●	●		●											
D-Länder	●			●	●	O	O	O	O	●	O					●	O		●	●
D-regional	●	O		●	●	O	O	O	O	●	●	O		●	●	●	O	●	●	●
D-local	●	●		●	●			●		●										
F-national*	●			●	●	●		●		●	●		●	●	●					●
F-regional*	●	●		●	●	●		●		●	●		●	●	●					●
F-local	●	●		●	●			●		●	●	●		●	●			●		●
NL-national	●	●		●	●	●	●		●		●	●		●	●	●	●		●	
NL-regional	●	●		●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
NL-local *	●	●		●	●	●		●		●				●	●	●			●	

O Meets some cases / ● Meets all cases of authorities along the Rhine river.

+ As regulation on EU-level the Water Framework was analysed. It is not integrated into national laws yet.

* In France a regional level does not exist (see chapter 2.2). Water management authorities in France are responsible for Catchment areas. In The Netherlands the water management authorities on local level (*waterschappen*) are responsible for polders. On this level only operational activities take place.

In spite of considerable differences, the participation of the public is required at most planning levels. At many levels, the legal regulations define the obligations for an exchange of information. Furthermore, there are generally valid regulations concerning personal data protection, copyright and the access to information on the environment.

3.3.2 Information technologies

Nowadays, technological aids are available for the management of data related to space (Geographical Information Systems, GIS) and for the control of operation processes and knowledge management (e.g. workflow, groupware and knowledge management software). However, the implementation of these information technologies by the responsible authorities along the Rhine varies greatly. Some trends can be recognised which should be taken into consideration when developing an information management system for preventive flood management:

1. Internet and intranets
   - Established almost everywhere – integrated topics differ enormously
   - Frequency and intensity of use decreases according to the public authority level
2. Workflow, groupware and knowledge management systems
   - Employed only in a few cases
3. GIS systems
   - A great deal of data has already been completely integrated
   - Common standard is the ARC/View/Info-Format – involves converting work however
   - Basic geodetic, water management and spatial planning data often do not match

3.3.3 Information management structure - perspectives

The progress in information technology allows a comprehensive information management. Tab. 9 shows tasks and strategies for an information infrastructure for preventive flood management in the Rhine catchment area on the different levels (compare chapter 2.2):

tab. 9: Information management structure for preventive flood management

Task	Strategy
Comprehensive knowledge of current data stocks	• Stepwise providing a multilevel metadata ("information about the data") – catalogue, operating at the various levels • Catalogue builds on sources of the European Environment Agency (CDS)
Comprehensive information management	• Creating informal working groups for flood management at the different levels • Working groups establish regulations for information management
Accessibility of information	• Free access for non-commercial users and back-flow of new data must be guaranteed • Making available metadata (information about data) to authorities and public via Internet • Making available data via central databases at the various levels
Data storage	• Central databases at the different levels store data from the various authorities from the corresponding levels and ensure technical data quality and exchangeability • Surveying authorities are responsible due to their experience in the handling of large data volumes • Support by interdisciplinary working groups with representatives from the upper and subordinate levels (river management, spatial planning, etc.)

Fig. 11 shows a suggestion for an information management structure along the Rhine including partners, activities and information needs of the different levels.

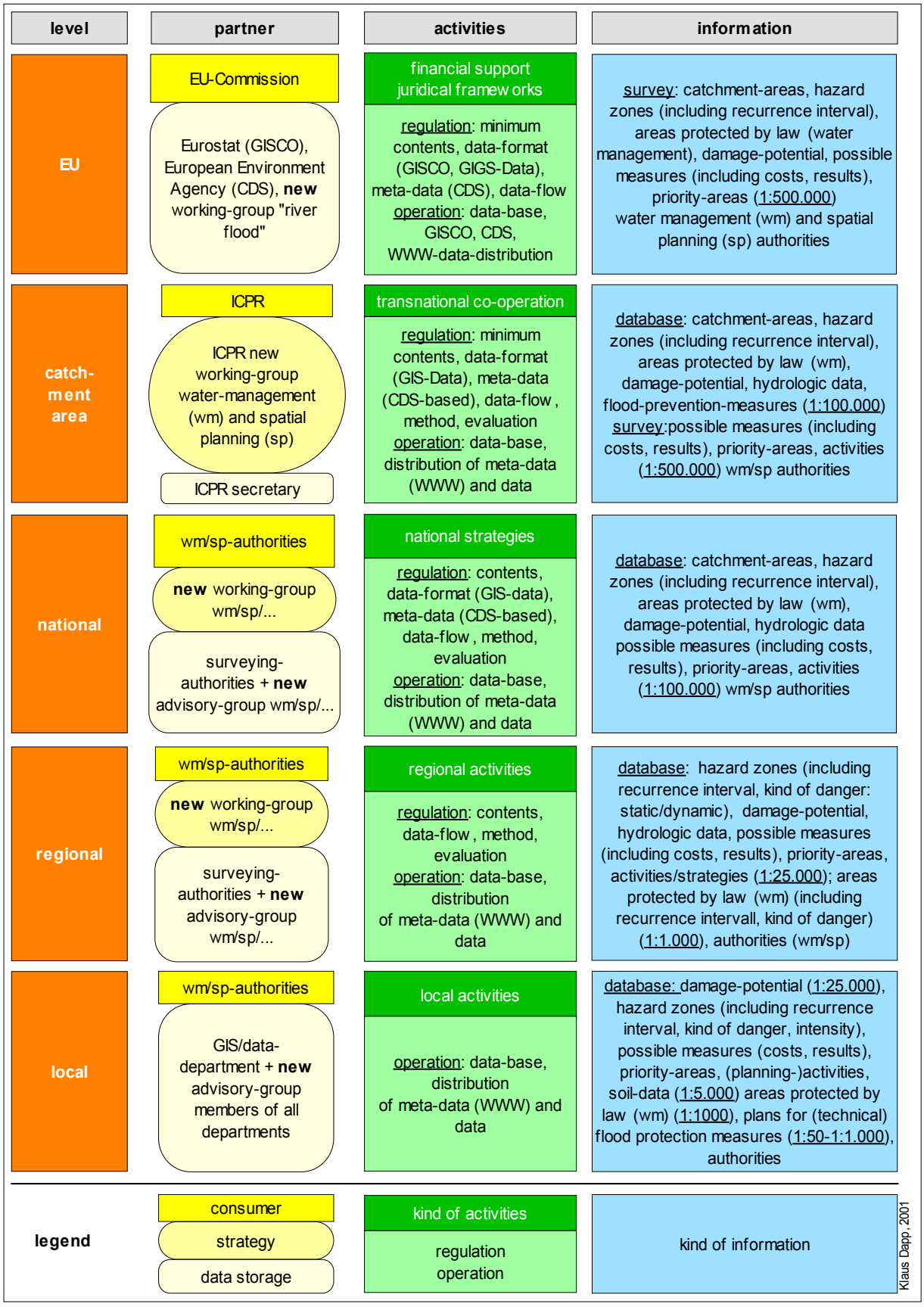


fig. 11: Recommended information management structure for preventive flood management

4 Public awareness and emergency management

4.1 Flood awareness and flood damage

Long periods without flooding can easily let the public and the authorities forget the potential flood hazard and set new priorities – e.g. in favour of economic development on potentially endangered land. It is an obvious assumption that an increase in flood awareness leads to a reduction in flood damage if a flood event occurs. An evaluation of building damage during the flooding of May 1999 at lake Constance in Switzerland showed that 1/3 of the property owners affected by the flooding of 1987 reported no damage in 1999 – although the flooding was 30 cm higher. This indicates that the precautionary measures, carried out after 1987, were successful. If a critical flooding period of about three weeks is exceeded, damage is caused to building structures even if the water can be kept out of the building. In addition, many temporary measures only have an effect for a limited period of time.

4.2 Information and communication at local level

The key actors in a municipality for establishing "hazard awareness" are the local authorities and emergency services (e.g. fire brigade). They rely on support of superior authorities to provide suitable information material, external experts etc.. Here, inter-regional co-operations should take place, particularly with information material of general nature. Furthermore, every possible opportunity should be used to pass on information to the population (at least every 5 years). The following means of information and communication are considered particularly suitable – and are often used insufficiently today:

- Information of the press and sending out information leaflets in simple words about the possible dangers and precautionary measures, use of information platforms belonging to the municipality such as internet, local information sheets or information notice boards
- Information events for inhabitants and the media – with the possibility of experts speaking (e.g. during other events like trade fairs or annual markets etc.) and visits to projects
- Integration of citizens initiatives especially to question the information- and protection-concepts
- House to house visits by experts in areas with a low population density using hazard maps.

Superior authorities must control the information flow to subordinate authorities and public.

4.3 Precautionary measures and self-reliance

Precautionary measures must be conceived to provide a sensible and feasible degree of protection in agreement with all those affected. Damage can only be effectively limited if public measures and private responsibility work together:

- Protection of every building is the responsibility of the house owner and occupants.
- A great deal of damage can be avoided by correct behaviour. Here, information leaflets and corresponding proliferation of information, for example tips on the radio, are helpful.
- For new buildings, the inclusion of building precautions in flood hazard areas must be obligatory - ensured in the planning process and the building approval procedure.

- For existing buildings, incentives for private protection measures can be introduced, for example by insurance companies (e.g. aid payments depending on the improvement of the protection; reduction of the insurance payment dependent on precaution measures).
- Technical guidelines for engineers, architects, the building owners and building authorities and handbooks for the population are important means.
- Flood protection societies or citizens initiatives can help to inform interested parties, represent interests and control, as well as support, authorities.

4.4 Public emergency planning

As well as the responsibility of the individual, measures from the authorities are indispensable. These require an emergency plan and the introduction of immediate relief measures after a flood, the realisation of follow-up projects and a success monitoring. Such concepts must be adjusted to the individual circumstances in any case. The general rule is that the earlier measures to prevent damage are taken (see no. 1 in fig. 12), the greater their effectiveness will be:

- Production of basic material such as hazard maps and action plans
- Set-up of an alarm system
- Provision and organisation of material
- Creation of flood hazard awareness in the public and the authorities.

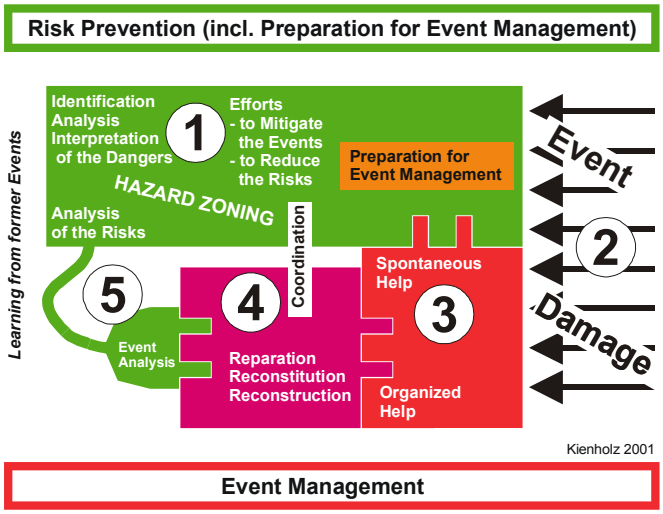


fig. 12: Risk management diagram

Success or failure of any event management depends on the information- and communication-flow. If a flood situation does occur, the first attempt should be to control the extent of the flooding (e.g. by flooding certain areas or redirecting the flow). When the flooding of settlements can no longer be prevented, the first priority is the protection of human life and secondly property with a high damage potential. After this, building precautions on individual buildings are made – either of temporary or permanent nature (no. 3 in fig. 12).

After the event, the first priority is to re-establish immediately the highest degree of protection possible with emergency measures (no. 4 in fig. 12). The basis for all follow-up projects must be an analysis of the flood event and the protection concept must be reviewed (no. 5 in fig. 12). This is the only mean to ensure that the initial situation is not simply re-established, but instead, that the really weak points in the protection concept are removed.

5 Conclusions and recommendations

5.1 Conclusions

Zoning instruments (in boxes: references to chapters of this report)

- Although spatial regional planning instruments exist in most countries in the Rhine basin their actual contribution to flood prevention is insufficient. The aims of the ICPR-action plan for diminishing the damage potential in flood risk areas could not be reached. 2.2
- There are large differences between regional plans in utilising the possibilities to control spatial development in flood risk areas. These primarily result from differences between the national planning systems and cultures and, unexpectedly, only to a small extent from differences in physical conditions throughout the catchment. 2.2
- Decision making on land use and regional planning in flood prone or detention areas does not sufficiently include the demands of flood management, especially not the benefits or negative impacts on regions situated far up/downstream. 2.2 / 3.1
- The administrative level which is responsible for land use planning, building approval and hazard zoning (in general the municipal level) is decisive for successful flood management, but they often give it low priority. 2.3
- A uniform method for flood hazard mapping at a detailed scale (1:2.000 – 1:10.000) in the whole Rhine basin has little practical value due to specific physiographic (size, elevation) situations. 2.3
- Hazard maps are not only an instrument of spatial planning but also for flood event management (e.g. evacuation). 4.4

Supporting instruments

- Co-operation between two or more authorities with the aim of reducing the flood risk is - with few exceptions - limited to governmental and high administrative levels and to water management networks, but does not reach levels of concrete land use decision making nor spatial planning. 3.1
- The current practice of financing flood protection measures and plans (1) misses "originator must pay" principles and (2) gives insufficient incentives for regions who bear the burdens. 3.2
- Much relevant information remains unknown to water management and spatial planning authorities or is not accessible because of structural (e.g. formal procedures, interests) or technical (e.g. data format, scale) reasons. 3.3
- The comprehensive possibilities of information technologies (such as GIS or workgroup systems) and information management methods are not fully exploited for flood risk management in the Rhine basins. 3.3

Public awareness of flood danger

- Flood risk awareness is event-driven and hence short-lived. A permanent dialogue between all the actors involved is lacking in many cases. 4.1 / 4.2
- Flood damage can only be effectively limited if public authorities, insurance companies and private persons work together and share responsibility 4.3
- Acceptance of flood protection measures may be enhanced by explaining the benefits for other regions to the local public and by incentives. 4.2 / 3.1 / 3.2

5.2 Recommendations

Zoning instruments (in boxes: references to chapters of this report)

- Existing regulative instruments for regional planning should be utilised extensively, instead of developing new ones. 2.2
- A transnational harmonisation of regional planning instruments is only sensible and necessary where joint planning is required. For these areas transnational models of spatial planning should be improved. 2.1 / 2.2 / 3.1
- A basic methodology for the regional planning approach (definition of areas for flood prevention) should be agreed on. A differentiated definition of priority and reserve zones is recommended. 2.2
- It is highly recommended to define concrete stipulations or limitations in local building regulations, for example minimum heights for openings in buildings. 2.3

Supporting instruments

- Local decisions must be co-ordinated on the regional or interregional level. 3.1
- The setting up of a co-operation structure of regional planning and authorities ("flood management alliance") is recommended to improve spatial planning and to start negotiations. Existing water management co-operations like the ICPR must be integrated. 3.1
- A fundamental change in the financing of flood protection towards burden compensation between regions and incentives for acting regions or municipalities is necessary. Strategies are budget funding of flood protection and negotiations between downstream and upstream regions. 3.2
- The basis for the exchange of information is a comprehensive knowledge of the current data stock. In this regard, a proposal for a stepwise internet-metadata-system is developed. Additionally it is strongly recommended to use the developments in information technology to improve the exchange of information (e.g. OPEN-GIS). 3.3
- A decentralised information infrastructure for river flood prevention has to be established for the Rhine basin. This infrastructure bases on existing authorities and data stocks. Surveying authorities should be responsible for technical data management (e.g. data format, exchange) while the owners of information are accountable for data content (e.g. updating). 3.3

Public awareness of flood danger

- The municipalities must be supported in the realisation of hazard maps by the superior authorities. Links to the emergency services must be included too, this also in order to keep awareness at a high level. 2.3 / 4.4
- In every municipality, suitable information material must be available. It must also be ensured that every information has been correctly understood and passed on to the next subordinate authority or the public. The information must be repeated in adequate temporal intervals in order to keep a high level of awareness. 4.2
- Each event management strategy must take into account local facts and structures. A key role for success or failure of every event management strategy is communication, which therefore must be very well prepared and checked regularly. 4.4