STORM Report Series No. 10
Simulation Tool for River Management

# Deciding About Safety

## Decision-making processes about high water protection measures in Germany on a regional scale

## STORM - RHINE

Contributing Report
M.Sc. Thesis
Tamar Leene
76.01.19.506.120

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M.Sc. thesis:

**Deciding About Safety**

Decision-making processes about high water protection measures in Germany on a regional scale

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IRMA project number: **3/NL/1/164/ 99 15 183 01**

**The IRMA-SPONGE Umbrella Program**

In recent years, several developments have contributed not only to an increased public interest in flood risk management issues, but also to a greater awareness of the need for improved knowledge supporting flood risk management. Important factors are:

- Recent flooding events and the subsequently developed national action plans.
- Socio-economic developments such as the increasing urbanisation of flood-prone areas.
- Increased awareness of ecological and socio-economic effects of measures along rivers.
- Increased likelihood of future changes in flood risks due to land use and climate changes.

The study leading to this report aimed to fill one of the identified knowledge gaps with respect to flood risk management, and was therefore incorporated in the IRMA-SPONGE Umbrella Program. This program is financed partly by the European INTERREG Rhine-Meuse Activities (IRMA), and managed by the Netherlands Centre for River Studies (NCR). It is the largest and most comprehensive effort of its kind in Europe, bringing together more than 30 European scientific and management organisations in 13 scientific projects researching a wide range of flood risk management issues along the Rivers Rhine and Meuse.

The main aim of IRMA-SPONGE is defined as: "*The development of methodologies and tools to assess the impact of flood risk reduction measures and scenarios. This to support the spatial planning process in establishing alternative strategies for an optimal realisation of the hydraulic, economical and ecological functions of the Rhine and Meuse River Basins."* A further important objective is to promote transboundary co-operation in flood risk management. Specific fields of interest are:

- Flood risk assessment.
- Efficiency of flood risk reduction measures.
- Sustainable flood risk management.
- Public participation in flood management issues.

More detailed information on the IRMA-SPONGE Umbrella Program can be found on our website: *www.irma-sponge.org*.

We would like to thank the authors of this report for their contribution to the program, and sincerely hope that the information presented here will help the reader to contribute to further developments in sustainable flood risk management.

Ad van Os and Aljosja Hooijer
(NCR Secretary and IRMA-SPONGE project manager)

Delft Cluster

Report Title:
**Deciding About Safety**
Decision-making processes about high water protection measures in Germany on a regional scale

(STORM-Rhine Contributing Report, M.Sc. Thesis)

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Delft Cluster verricht lange-termijn fundamenteel strategisch onderzoek op het gebied van duurzame inrichting van deltagebieden.

# Preface

The thesis has been written in the framework of the study Land-use Planning at the Wageningen Agricultural University. The subject of this thesis is decision-making processes in German river management. The process to write this thesis was long, too long. Mainly due to a bad demarcation at the beginning of this research which made it hard for me to focus on my research questions. Therefore I have not only learned something about decision-making processes in German River Management, but even more about decision-making in thesis writing processes.

In this preface I like to thank my mentors, Mr. Lengkeek and Mr. Heun, for their patience and their help in the production of this thesis. Furthermore I would like to thank everyone that was involved in the process…..like always… too many people to mention

Tamar Leene
26 August, 2002

# Summary


**Introduction**

As a result from spatial developments and the changing climate, flooding risks of rivers have changed. In order to reduce these risks measures have to be taken in the catchment areas and cross sections of rivers. These measures have to be prepared by the organisations that are involved with water management.

In the Netherlands one of the rivers that deals with changing flooding risks is the Rhine. In order to take measures an international co-operation has to be developed between the countries involved with the management of the Rhine. In order to create such a co-operation insights have to be gained in how rivers are managed in other Rhine countries and which organisations have to be involved in an international river management organisation.

A tool that can support this process is STORM: a management simulation that gains insights in the intricacies of river and floodplain management of the Rhine. In order to develop STORM insights have to be gained in (a.o.) the German river and floodplain management.

This research gives insights in German River and floodplain management on a regional level in order to identify which elements and relations are the driving forces in the development of the discharges of the Rhine and therefore should be represented in STORM, and examine if STORM is capable of representing these elements.

**Method**

The methods used in this research are:
- A theoretical analysis about changes in the spatial organisation.
- Literature study about spatial organisation and the institutional system in Germany.
- Interviews with relevant organisations in Germany.

**Theoretical framework**

Changing of the discharges are the result of changes in climate and changes the spatial organisation. Climate changes fall out of the scope of this research.

Changes in the spatial organisation are the result of two systems that influence one and another: the physical system and the social system. The physical system is the interaction between the biotic and a-biotic system and is low dynamical. The social system consists of the people in society that influence the spatial organisation. The claims on the physical system from the social organisation are the result from the interaction of three sub-systems:
- the economical sub-system that relates to the claims that arise from the production and distribution of knowledge, products and services;
- the political sub-system that is the domain of the debate concerning public matters and results (amongst others) in spatial policy and regulation;

- the cultural sub-system that relates to the prevailing standards in society, and influences the debate in the political sub-system.

The driving forces behind the claims from these sub-systems are (groups of) actors: the institutional system. Each actor can be characterised by interests and resources of influence. This combination is the basis for their behaviour. Not all actors have defined clear objectives concerning the use of the physical system. In this matter their interest is the basis for their behaviour. When the behaviour of other actors, or a development in the physical system, influences their interest, they translate their interest in an attitude towards this behaviour or change. The attitude is the basis for the use of their resources of influence.

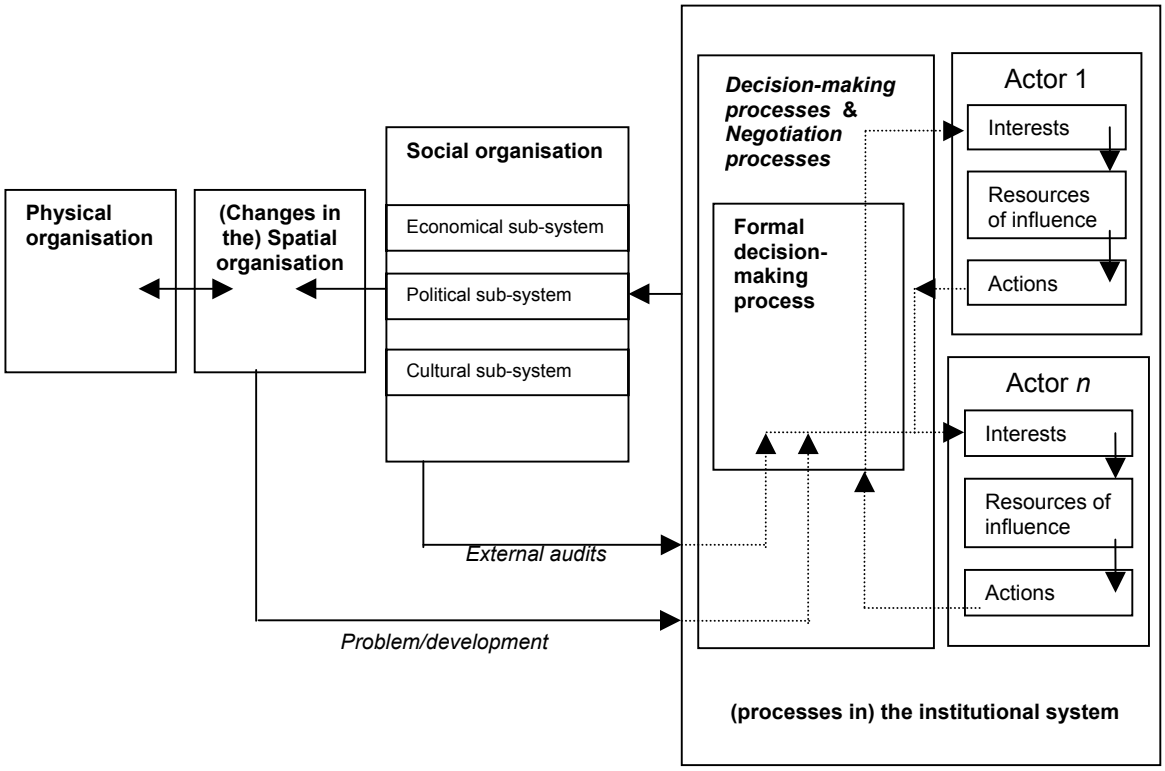
Resources of influence are the means actors have to realise their own objectives but also to influence others in realising their objectives. There are six resources of influence:
- Power that derives from legislation or material resources;
- Legitimacy that is close related to the prevailing standards;
- Networks: the formal and informal contacts actors have with others that can be a basis for forming alliances in processes;
- Knowledge: information that is not available for all actors related to a certain project.
- Performance skills: personal characteristics in order of representatives of stakeholders.
- BATNA: Best Alternative to a Negotiated Agreement. The power related to the dependence on co-operation in order to reach individual objectives. This power derives from the other resources of influence.

Most actors are dependent on others in order to realise their objectives. Therefore interaction processes take place. These can be sub-divided in formal and informal processes. In policy matters concerning spatial development formal processes are often organised and different actors (that can influence the implementation of the outcome or are needed for the development of better policy) are involved within a in front set-up procedure to come to a decision. Outside these formal processes also informal processes take place because (groups of) actors that are not involved influence the outcome of the formal process.

The processes of interaction can be interpreted as negotiation processes. In this matter, two forms of negotiation can be distinguished. Integrative negotiation where participants define a common objective and take care of the other. Distributive in which actors only look at their own interests. In general integrative negotiation is more sustainable than distributive negotiation because participants are accept the common problem.

Besides the (characteristics of) actors and their behaviour, the characteristics of the decision-making process also external audits can influence the outcome of interaction-processes and therefore the way the institutional system influences the spatial organisation.

This is reflected in the conceptual framework.




***The scope of this research***

The case study focuses on:

- The objectives and resources of influence of (relevant) actors and the way these influences interaction processes (decision-making processes).
- The organisation of these decision-making processes.
- The relations between the above and the spatial organisation.

The driving forces in the physical system (therefore also climate changes) fall out of the scope of this research.

***Problem definition***

> *How do the characteristics of the actors in the institutional system and the processes between these actors influence the spatial organisation regarding the discharge capacity of the Rhine, how does the social organisation and spatial organisation trigger these processes, and is STORM capable of simulating these characteristics and processes?*

**Case study**

***The case study area***

The case study area is a part of the upper Rhine between Worms and Mainz, where high water peaks occur during winter. The area that is relevant from a discharge point of view is constructed of three physical elements with each its own hydrological characteristics: the river, the floodplains and the land behind the dikes.

Although the case study area is part of the most densely populated areas of Germany, the region itself has a more extensive land use. Except for the cities Worms and Mainz there are no large cities adjacent to the river, and the land-use is mainly agriculture. Furthermore, there are ecological valuable areas located in the floodplains of the Rhine, which are protected in the European policy. The Rhine itself has an important navigation function.

***Actors, interests and resources of influence***

In the table at the end of this summary the characteristics of actors relevant for the assets in the case study area are reflected.

***Decision-making processes: two cases***

In the framework of high water threats in the past, an international agreement has been made between three German states and France. In this agreement two German states committed themselves to the construction retention areas. In the case study area this concerns the State Rheinland-Pfalz.

The case study concerns the construction of two retention areas, one in each state. In both states the processes were triggered by the occurrences of high water in 1993 and 1995.

In Hessen the process to construct failed due to a bad process organisation, the nature of the measure that was conflicting with economical interests, the alternative that they had to their disposal (not to construct) and the description of governmental responsibilities in the federal law. This law only makes them responsible for the safety of the inhabitants in the state, and not for down-stream located states. The safety of their own inhabitants could also be guaranteed by strengthening the winter dikes.

In Rheinland-Pfalz construction was successful. First off all because of the different attitudes of actors towards the plan (and the instruments that these actors had to their disposal) as a result of the commitment and skills of the minister. Other politicians shared here objective because of the protection of economical interests. The absence of the responsibility for the safety of down-stream located areas was not a problem because Rheinland-Pfalz had committed itself to this responsibility in the agreement of 1977. The only alternative was to construct on another location, but there the same (or even more) problems would occur. This led to a more careful planed decision-making process on the side of Rheinland-Pfalz.

**Conclusions regarding the case study**

The spatial context and the culture determine the attitudes of actors towards measures or developments that influence the discharge capacity. When these change gradually, there is little reaction of the institutional system. When these change in a high rate, like high water peaks or governmental measures, the institutional system takes action. Therefore: occurrences trigger the processes in the institutional system.

Their attitude towards the developing of the spatial organisation depends mainly on the spatial situation and therefore the effects on their interests and the cultural climate. In governmental organisations the attitude is also determined by governmental responsibilities settled in the law, like

the responsibility for safety. Dependent on the attitudes and/or objectives and the available recourses, the actors take actions to pursue their objectives. In this matter the following resources are the most influential: power (status and competencies), legitimacy and the BATNA. The influence of process organisation is difficult to judge, but likely of little influence. The outcome of the processes in the institutional system are translated in policy that co-ordinates the spatial development.

***Comparing the case to STORM***

When the outcomes of the cases are compared to the design and functioning of STORM, it becomes clear that all elements can be modelled to a certain extend. The characteristics and processes in the institutional system can be influenced by the simulation, the effects of this or can be neglected or prevented. However, an import element of the process takes place outside the model. The registration of this part is however important for the objective of STORM.

Second, in order to get a good representation a large number of parameters is needed because it concerns a complex situation. The more abstracted the model is, the less suitable for research. However, in order to keep the simulation playable, a limit should be put on the complexity of the simulation.

***Final conclusions***

The final conclusion therefore is that STORM can represent an abstracted model of the German river management situation. A more detailed model (that is needed for research) requires an elaborated analysis that supplies the research data. However, this model will be to complicate to play. The abstracted model is mainly suited for supporting decision-making processes.

| Organisation | Interests in relation to the measures | Resources of influence |
|---|---|---|
| WSV | • Keeping the river navigable and therefore a water level that is between +2.10nap and +6.50 nap.<br>• Prevention of sedimentation.<br>• Prevention of side-streams that can affect the stability of the river. | • Decision-making rights in all procedures that interfere with the cross-section of the river.<br>• Decision-making rights in all procedures that concern distracting water out or draining water into the river.<br>• Participation-rights in all procedures that influence the capacity of the floodplains.<br>• Status of federal government.<br>• Representation of economical interest. |
| State government | • Protecting inhabitants against flooding.<br>• Restoring the safety to a HQ 200 (both states)<br>• Reconstructing a retention capacity of 60 mln. M3 (Rheinland-Pfalz).<br>• Economical growth.<br>• Increasing awareness of flooding risk. | • Right of giving approval in all procedures.<br>• The right to point out locations for retention areas. |
| Regional government | • Protecting inhabitants against flooding.<br>• Restoring the safety level of the land behind the winter dikes to a HQ 200 (both states)<br>• Reconstructing a retention capacity of 60 mln. M3 (Rheinland-Pfalz).<br>• Economical growth.<br>• Increasing awareness of flooding risk. | • Decision-making rights concerning all changes in land-use in the floodplains (water department)<br>• Pointing out reservation areas for retention-areas (spatial department).<br>• Making decisions concerning height of winter dike (water department)<br>• Making decisions on water distraction and draining in the Rhine and the groundwater.<br>• The right to participate in all procedures on local and state level.<br>• Financial means. |
| Local government | • Maintaining all economical functions in the municipality (industry and agriculture).<br>• Protection of inhabitants against flooding.<br>• Prevention of groundwater problems | • Decision-making right of the maintenance of summer dike.<br>• Participation in all spatial procedures. |
| Nature protection organisation | • Protection of marginal vegetation in floodplains.<br>• Vegetated riverbanks.<br>• No sudden flooding of floodplains.<br>• Possible expansion of natural areas in floodplains. | • Participation in all spatial procedures.<br>• Media support for ecological interests.<br>• The obligation of governments to compensate decrease in natural surface. |
| Economical interests | • Protection of current economical companies in or near floodplains and possibilities to expand.<br>• Maintenance of navigability of the Rhine<br>• Reasonable ground prices and therefore not large demands for nature protection. | • Bad economical climate and therefore public acceptance of interest.<br>• Social contacts with public representatives in the governmental organisations.<br>• Participation in decision-making procedures concerning all spatial developments. |
| Agriculture | • Maintenance of agricultural surface in floodplains and behind winter dikes.<br>• Maintenance of summer dike.<br>• No increase in the groundwater level. | • Organisation in official interest group and contacts with local government.<br>• Possession of grounds. |

*overview of the involved actors, their interests and their means*

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# 1. Introduction

## 1.1 Introduction

This research is part of the STORM research about simulating International River management. Until now, the research mainly focussed on Dutch river management and modelling the intricacies of river management in computer models. This research focuses on the German river management. The outcomes of this research will be integrated in the research program of STORM.

## 1.2 Background

***The need for a new view on river management***

The landscape of the middle and south of the Netherlands is dominated by the rivers Rhine and Meuse. In former times rivers ran wild through the landscape and, in times of high water, flooded the areas around it. During this period people settled on the higher areas, while the lower areas, that were frequently flooded, were mainly used for pasture. By embanking the rivers also the lower areas of the former floodplains became suitable for more permanent forms of land-use. People started building houses and industrial companies along the river assuming that the river dykes would protect them against high water.

As a result from climate changes and interventions within the natural environment, such as river bed engineering, river straightening, non-permeable surfaces and intensive agriculture, the draining capacity and the hydrograph[1] of the river have changed (Böhm & Heiland, 2000). This has led to a number of dangerous high water peaks, which caused flooding risks in the downstream areas of rivers.

The high water levels in 1993 and 1995 in the Netherlands have shown that the areas behind the dykes have a higher flooding risk than expected. Especially the evacuation of 250,000 people in 1995 raised the awareness among the people and politicians that there is a strong need for measures to protect areas against possible flooding (VROM, 1999). Not only the Netherlands, but also other European countries had to deal with these problems, for example Germany.

The solutions for these problems have to be developed on the management level. Until now, the existing management has not shown to be capable of developing and implementing these solutions. Therefore it is needed to point out the weaknesses of this system and make recommendations for improvements. In this matter, the concepts of river management will be discussed.

***Concepts of river management***

[1] The hydrograph reflects the developments in the discharge along the time.

In large river basins and their floodplains, managers have to deal with a multitude of users, policy and decision-makers that influence the highly interrelated processes, which determine the state of the river and the dependent river functions. Depending on their background, the stakeholders attribute quite different values to the physical, environmental and spatial river and floodplain functions (Schmidt, 1998). In this matter the social environment of river basins and their floodplains can be interpreted as a complex system. Complex systems are characterised by a large number of variables with unknown relations, in which a large number of organisations are involved (Caluwe a.o., 1996).

The management of rivers and their floodplains will be referred to as river management systems. River management systems are defined as: the administrative structure involved with river management including all, for policy development and implementation in river basins and in particular their floodplains, other relevant stakeholders.

In the river management system that is concerned with the risk of flood occurrences in the complex environments, guaranteeing a sustainable[2] use for all important functions, two related concepts have to be taken into consideration: integrated river management and river basin management. Both concepts are close related,

*Integrated river management*

In order to define the concept of integrated water management, first water resource management has to be defined. Water resources management is the whole set of technical institutional, managerial, legal and operational activities required to plan, develop, operate and manage water resources. The concept integrated water management advocates that in water resource management (a) all natural aspects of the water resources (b) all sectoral interests and stakeholders (c) the spatial variation of resources and demands (d) relevant policy frameworks and (e) al institutional levels have to be taken into account (Savernije, 1997). In other words: in the process of developing water management policy, all relevant interests should be weighed.

*River basin management*

Nowadays, rivers are often managed according to the existing administrative structures[3], with the greatest responsibility (for the Dutch main waterways) at the level of the national government. A great number of the European rivers however are shared between two or more countries. Therefore it would be more logical to manage rivers on a larger scale, the river basin scale. This way all interest will be involved instead of the interest within the administrative borders. In the recommendations that have been developed in the framework of the Second World Water Forum, this consideration has been formulated as follows. The interactions between parts of the river basin (upstream-downstream, tributary-mainstream, land-water, surface water-groundwater, etcetera) are so strong that the system as a whole is the logical level for taking such measures. Water management policies for the local, national and international scales need to be co-ordinated with the policies formulated at the river basin scale (VROM, 2000).

[2] Sustainable development is a development which meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland in: Elliot, 1996)

[3] For some parts of these policies international agreements have been made. However, the responsibility lies at the current administrative systems.

A document that subscribes the need for river basin management is the European Union Water Framework Directive. This document divides Europe in a number of river basins that form the basis for future river management.

Both concepts advocate involving all interests in decision-making in river management. In large river basins in which flood problems occur, this concerns a great number of interests and even a greater number of involved organisations. On of the main problems managers have to deal with in these situations is how to be informed and how to involve these interests. A tool that can support this process of gaining insights in the interests is management simulation.

***Management simulation***

In order to explain the concept management simulation the term simulation deserves some elaboration. Simulation is an attempt to abstract and reproduce the central characteristics of a system in order to understand, experiment and predict the behaviour of this system (Duke in: Caluwe a.o., 1996). Systems are objects and the relations between these objects and can vary from technical systems to social systems.

In a management simulation the system of interaction between actors and the effect of this on an object is being simulated. Every actor has its own objectives concerning an object and means to influence this object. In order to reach their own objectives, they need to interact. By simulating the behaviour that they show in reality, insights can be given in how the object develops. Because in real life the behaviour is often limited by a number of rules, these rules are also valid in the simulation.

The consequences of the shown behaviour become perceivable in a short amount of time, while in reality it may take years before consequences become perceivable. The performance of options can be compared using socio-economic and environmental indicators, such as parameters for flood risks and water quality. While technical reports are often hard to read for non-specialists, management simulation makes it possible to present and discuss rather complex issues in an attractive and holistic way.

Management simulations are often constructed out of a number of rounds. Between these rounds the actors can evaluate their behaviour. Also they can choose to experiment with new forms of behaviour. In this matter the facilitator of the simulation has an important function. He has to take care that participants reflect their own behaviour and are capable of making the translation of the game to reality (Caluwe a.o., 1995).

Management simulations can have different functions. These functions are not exclusive, simulations can also have multiple functions. Mayer distinguishes the following objectives (a broader description of these functions is given in annex 1)

- Training: The learning of a new skill.
- Research: The gaining of insights in the behaviour of a certain group.
- Learning: the creating of understanding among participants about situations and other participants. The function learning can be subdivided in mirrors and windows. Mirrors refer to

the gaining insights in the existing situation. Windows refer to the becoming aware of the consequences of their behaviour (Caluwe a.o., 1996).

- Intervention: The changing of behaviour of participants. For this objective, management simulations should be used in combination with other tools that support participants to maintain the changed behaviour (Caluwe a.o., 1996).
- Exploring: The exploring of the behaviour of new systems (e.g. new policy) in order to foresee problems that can occur during implementation or new problems that the new system can generate. Furthermore, exploring can also be used for generating new alternatives.

In the framework of integrated river basin management, the Delft Cluster has developed the management simulation STORM.

***STORM***

STORM (Simulation TOol for River Management) has been developed in order to get insights in the different interests of decision-makers and users concerning river management. The objective of the STORM project is research, however, in a later stage it could be applied in decision-making processes. The research objective has been formulated in the following way: STORM has to provide insight in the intricacies of river and floodplain management, showing the links between natural processes, spatial planning, engineering interventions, river functions and stakeholder interests. To reach this objective a management simulation tool must be developed, that stimulates a structured and innovative dialogue between the relevant stakeholders in a river or floodplain management related planning process.

Until now two versions of the STORM project have been developed that both focus on sections of the Rhine. The first is the STORM-BETUWE (Dutch River Rhine). In this version the development of a generic role-play, and the elaboration of this concept into a specific role play on the management of the Dutch Floodplains, was the main point of attention. This version also contains a model of floodplains, describing the effects of the player's decisions. The second version was the STORM-DELTA. The STORM DELTA is a one-player version of the role-play. The main objective is to gain insights in the river functions of and the measurements that have to be taken in the Dutch Rhine and IJssel.

| | STORM BETUWE | STORM DELTA |
|---|---|---|
| Objective | Role play generation | River modelling |
| Players | More players | One player |
| River | Imaginary river and floodplains | Rhine and IJssel |

*Figure 1: overview on the existing versions of STORM*

In the framework of the concept river basin management the developers of STORM want to make the simulation suitable for the use on an international scale. Therefore, analyses should be made of the river management systems in other Rhine countries. This research is part of the analysis of the German river management system.

## 1.3 Objective

As discussed in the previous section, STORM is designed to gain insights in the intricacies of river and floodplain management, showing the links between natural processes, spatial planning, engineering interventions, river functions and stakeholder interests. However, in later stages it can also be applied in facilitating decision-making processes concerning river and floodplain management. In order to come to a successful development of STORM on river basin level, first the existing design of STORM should be examined on representativeness for other Rhine countries. This research takes place in the framework of the development of a German version of STORM. Therefore two researches have been conducted that analyse the German system of river and floodplain management: one on a regional level and one on a national level. The first research should gain insights in the intricacies of river management on a regional level, the second should examine the representativeness of the regional level for the other German regions through which the Rhine flows. This research concerns the first of these two researches: the regional level.

In this matter it should be noted that the intricacies of river and floodplain management in this research only concern issues that relate to water quantity and not to water quality.

All has been translated in the following objective:

> *Gaining insights in the developments in the German river and floodplain management on a regional level, showing the links between natural processes, spatial planning, engineering interventions, river functions and stakeholder interests, in order to identify which elements and relations are the driving forces in the development of the discharges of the Rhine and therefore should be represented in STORM, and compare the outcomes of this case study to the design of STORM.*

## 1.3 Structure of the report and direction for reading

***Structure of the report***

This report is constructed of four parts:

- the translation of the objective in the problem definition and research questions;
- the case study analysis;
- the comparison of the conclusions regarding case study to the design of STORM;
- the general conclusions and recommendations.

The theoretical framework gives a theoretical background of processes behind changes in the discharge capacity of rivers. Based on this theoretical framework important elements (driving forces) behind spatial developments are identified. Chapter three, the analytical framework, demarcates the objective of this research and translates it in the problem definition and relating research question. The elements of spatial development and their relations, distinguished in chapter two, are visualised in a conceptual model.

Chapters four, five, six and seven describe the case study. The structure of the description of the case study is based on the analytical framework and the research questions formulated in chapter three. Chapter eight will discuss the conclusions regarding the case study.

Chapter nine compares the conclusions of the case study to the design of STORM.

Chapter ten will give the main conclusion and recommendations for further research.

This report contains three annexes. Annex one describes the design and functioning of management simulations and STORM. Annex 2 describes measures to increase or decrease the discharge capacity of rivers. Annex 3 describes phases in decision-making processes.

***Directions for reading***

This report is focussed on readers that are already informed about management simulations and STORM. For readers that do not have background knowledge about Management Simulations and STORM, a description of both is added in annex 1.

Readers that are already familiar with theories about decision-making and processes behind spatial developments, the case study can be read separately from the theoretical framework.

# 2. Theoretical framework: changes in the spatial organisation

## 2.1 Introduction

Flooding risks in a region or in downstream areas of these regions can be decreased or increased by certain measures. Some of these measures influence the supply of water to the river, others influence the discharge capacity of a river. This last group of measures takes place close to the river: in the cross section or in the (former) floodplains. These measures will be referred to as direct measures[4] there they have a direct influence on the discharge capacity of the river. An overview is of these measures is given in annex 2.

All of the measures that direct influence the discharge capacity can be interpreted as a change in the spatial structure or organisation of the river. Therefore, in this report, direct (river management) measures that aim at reducing flooding risks are interpreted as spatial measures. This chapter will discuss the driving forces behind these spatial measures that lead to changes in the spatial structure.

The objective of this chapter is to give a theoretical background of processes behind changes in the discharge capacity in order to formulate the research questions for the case study. This chapter is constructed out of 6 sections. Besides the introduction these are: the elements of spatial organisation, actors and policy-arena's, objectives, interests and attitudes, resources of influence and interaction processes between actors.

## 2.2 Elements of the spatial organisation

The landscape and the processes that form this landscape is can be interpreted as the result of two different systems: the physical organisation and the social organisation. Together they form the spatial organisation (figure 2). Both systems are closely related to each other. On the one hand, the physical organisation provides opportunities for the realisation of certain institutional objectives. On the other hand actions in the social organisation can affect the physical organisation through interventions, for instance changes in ground water levels (Hidding, 1997).

The physical organisation is the result of human interactions in the natural substrate. The natural substrate is the product of the interaction between the living and dead nature (biotic and a-biotic system), which is composed of the elements water, soil, air, plants and animals. The processes in the natural substrate take place without a preceding human action. Nevertheless, human interventions (actions) can influence the processes that take place in the physical organisation (Hidding, 1997).

[4] Contrary to indirect measures, which influence the supply of water and have an indirect influence of the discharge of the rivers.

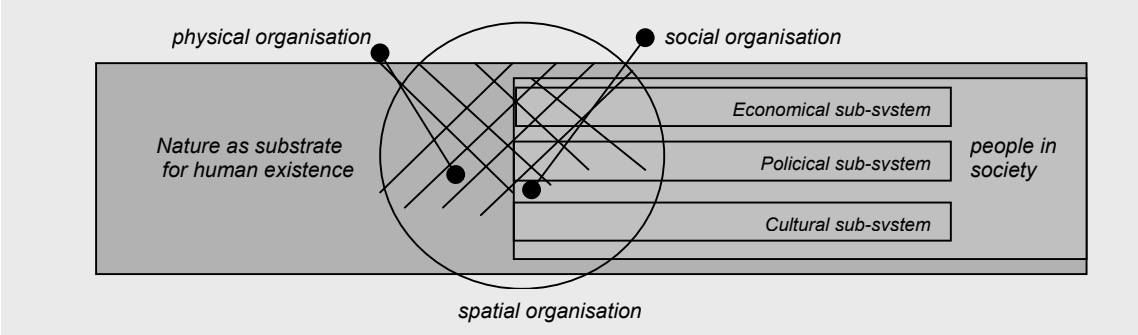



*Figure 2: The spatial organisation*
*Source: van der Vlist, 1998*

Without the social organisation, the spatial organisation would change very slowly as a result of the low natural dynamics of the physical organisation. The social organisation is composed of three sub-systems, which are related to each other:

- The economical sub-system: The economical sub-system is concentrated on the production en distribution form knowledge, goods and services. The assets that generated from the economical sub-system are close related to those of the market economy, and can be derived from ownership and land-use.
- The political sub-system: the political sub-system is the domain where the debate and decision-making concerning public issues takes place. It fulfils a regulating function between the economical sub-system and the cultural sub-system. The legislation and policy concerning the spatial organisations is part of this sub-system.
- The cultural sub-system: the cultural sub-systems are the prevailing standards and values in society. The cultural sub-system is close related to the concept legitimacy, a concept that will be discussed later on (Hidding, 1997).

The motor behind the social organisation is the interaction between (groups of) individuals related to the spatial organisation: actors. Most actors have certain assets or objectives concerning the spatial organisation and take actions to realise these objectives. Which actions take place and how actors influence each other is dependent on the characteristics of these actors, but also on the way they interact.

The actors, their values and objectives and their resources of influence are in this research defined as the institutional system. Therefore, the institutional system and the processes in this system are the motor behind the social organisation and influences the (changes in the) spatial organisation.

## 2.3 Actors and policy-arena's

### *Actors*

An actor is an acting unit. When an actor has a certain interest in an area, they are called stakeholders. Stakeholders can be one person or a collective. Besides stakeholders there are also decision-makers. Decision-makers are those actors that are authorised (for instance by the law) to make decisions. In spatial policy problems these organisations are mainly governmental organisations.

Within the group of stakeholders, a further distinction can be drawn between interest groups and principle groups. An interest group consists of people that have a certain (self-) interest and unite themselves in order to represent this interest in society. Principle groups are organisations that share social values and want to defend and spread these values. An example is an environmental protection group. Sometimes, interest groups represent themselves as principle groups in order to increase the external legitimacy (Berkers a.o., 1996). Concerning spatial issues, self-interest groups can be sub-divided in three categories: interests related to ownership, interests related to land-use, interests related to research.

There are a large number of distinctions between actors. This research will distinguish two groups of actors:

- The administrative system: actors responsible for policy development and involved in decision-making. Concerning spatial policy this mainly concerns governmental actors. This group of actors is comparable to those that form the driving force behind the political sub-system.
- The socio-economic system: actors related to interests that derive from land-use, ownership or research. These actors correspond to a large extent with the actors that form the driving forces behind the economical sub-system.

***Relations***

Actors are related to one and another. The actors and their relations are referred to as networks. Within networks relations are based on interdependency. Interdependency is the result of the dependence of an organisation on the means of other actors for realising its objectives. The extent of dependency is based on the ambitions of an organisation, the possibility of substitution of the means and the importance of the means for the primary activities of actors (Andriessen, 1989; Berkers a.o. 1996; Teisman, 1998). The concept interdependency can also be interpreted as a resource for influence: the BATNA. This will be discussed in section 2.5.

Decisions that lead to changes in the spatial organisation will influence all relations within a network. The part of the network that is “activated” is referred to as the policy arena. The policy arena is not a stable network. Every time something changes within the spatial organisation, interests of other actors in the arena are affected, and their position changes. Some actors loose their interest in a certain situation, and they are no longer a player in the arena. New actors get involved and they take place in the arena. Within the policy arena formal processes can take place. These will be discussed later on in this chapter. However, it should be noted that formal processes are influenced by the processes that take place in the policy area, and vice versa (Teisman, 1998).

The behaviour of actors in the policy arena, and therefore the assets on the physical system, depends on two characteristics:

- their objectives and interests;
- their resources of influence to realise their objectives and interest and their dependence on others to realise them.

## 2.4 Objectives, interests and attitudes

The way actors deploy their recourses of influence on the spatial organisation depends on their objectives. Some actors have not translated their interest in clear formulated objectives and do not take actions to change the spatial organisation. These actors often do know what they do not want to happen. When other actors initiate a change in the spatial structure, this is the basis for their behaviour (Teisman, 1998).

The concept objective is close related to the concept interest. Interests are translations of general ideas and preferences in concrete wishes towards a specific situation. Interests consist of two elements: an interpretation of a certain object or activity and a value related to that interpretation (Berkers a.o., 1996). For example, an actor that interprets a city centre as a place for shopping and gives a high value to shopping, will have a great interest in changes in this centre (e.g. a new parking garage). The value is not only dependent on the interpretation but also on specific characteristic. For instance, an actor can give a higher value to a shopping centre in the neighbourhood then in an adjacent city.

The different interests and objectives of actors concerning an issue (an object or a situation) can relate to each other in three ways: conflicting, conditional and win-win. Conflicting means that the interests of one actor exclude each other. When interest are conditional, one interest has to be respected in order to respect another interest. Win-win means that both interests can be implemented without involving each other, but when they are both implemented the result for both actors will be more than when the other was not implemented: the total quality will increase. When interests are not related, and the implementation of one interest does not influence the implementation of another, they are independent.

When other actors initiate a change in the spatial organisation or address a certain problem, an actor translates his objectives or interests in an attitude. Kaufman (1995) divides this attitude towards the spatial change into two elements: basic position and specific concerns.

- The basic position is the attitude that an actor has towards a certain problem that is addressed or a possible change (or solution) that is initiated. The basic position can be expressed in a numeric system or a normative system, for instance in favour, against or neutral. In order to manipulate the attitude of an actor, the basic position provides to little information. Therefore, the basic position can be sub-divided in to specific concerns.
- Specific concerns try to explain the basic position. Kaufman (1995) identifies four features of specific concerns that try to explain the basic position of an actor towards (possbile) solutions for problems: concerns about the complexity, concerns about the radicalness, concerns about non-adaptability, concerns about its effectiveness.
  Van Woerkum (1997) gives five specific concerns regarding governmental measures.
  - Acceptance of the motive: is an actor informed about the problem and the degree of seriousness;
  - Acceptance of the need for intervention: this concerns the need for intervention by the involved government for this specific problem;
  - Acceptance of the measure as effective: does the measure work as intended;

- Acceptance of the measure as being realistic and applicable: are there possibilities to implement the measures.
- Acceptance of the measure as being fair.

## 2.5 The resources for influence

Influence refers to the power actors have over a project or situation; to control what decisions are made, facilitate implementation or exert influence which affects the project or situation negatively. Influence is in fact the extent to which the actor is able to persuade or coerce others into decision-making and/or implementation of actions. Figure 3 shows some variables affecting actors relative power and influence (de Groot, 1998).

| *Governmental organisations* | *Stakeholders* |
|---|---|
| Legal Hierarchy (command and control, budget holders). | Significant linkages with other stakeholders |
| Authority of leadership (formal and informal, charisma, political). | Degree of organisation, consensus and leadership in the group. |
| Control of strategic resources for the project. | Degree of dependence on other stakeholders. |
| Possession of specialist knowledge. | Social economic and political status. |
| | Control of strategic resources for the project. |
| | Possession of specialist knowledge. |

*Figure 3: variables affecting actors relative power and influence (Source: ODA in: de Groot, 1998)*

The variables affecting actors relative power and influence by De Groot can be translated in more general descriptions that were developed by other authors. Kaufman (1995) defines five forms of resources: power, legitimacy, knowledge, relations, performance skills. Based on other literature (Berkers a.o. 1996, Teisman 1998; Voogd, 1995), relations will be referred to as networks. These five forms cover all description in figure 3 besides “degree of dependence on other stakeholders”. Therefore a sixth form can be added, which is more or less the result of the other five resources: the Best Alternative To A Negotiated Agreement (BATNA).

### *Power*

Kaufman (1995) interprets power as the means to influence or compel a decision-making process. In this definition power is restricted to the process. In some visions power go beyond this process and is also the capacity of actors to keep certain issues out of the agenda or even prevent them from becoming a problem by influencing the interests of other actors (Lukes in: Berkers a.o., 1996). In both definitions power is the product of all means that are described in this section. A more narrow definition is given by Hood (in Teisman, 1998) that interprets power as a set of administrative tools that are applied by the government to shape the behaviour of society. A weakness of this definition is that it implicates that administrative tools can only be used by governmental organisations[5], while in reality they are also used by other parties. An example is the right to protest against spatial plans.

[5] Teisman (1998) used this definition in a paragraph that discussed instruments in a society an uni-centric perspective, which means a perspective in which the government is not dependent on other parties for spatial development.

Power however does not only come from legitimate resources, but also from material resources. These can be financial means that are needed for the realisation of a project, but also from other forms of property. In spatial planning the ownership of land forms a great form of power, especially for farmers. These forms of ownership however are indirect related to legislative means because, when interests are not taken into account, actors are able to delay the process of implementation by going to court. Based on these considerations, power will be defined as legislative and material means that actors can use to influence the decision-making process.

***Legitimacy***

Legitimacy refers to the acceptance of a problem as being valid. The acceptance of a problem depends on two questions:

- Is the objective accepted? This refers both to internal acceptance as external acceptance. Internal acceptance is the acceptance by the different sub-cultures within an organisation. This is mainly of importance within the government that is divided into a great number of sub-cultures. External acceptance is the acceptance by other organisations, and is also referred to as societal acceptance (Berkers, 1996), which is related to the prevailing standards and values.
  Concerning (principal- and self-) interest organisations, the number of members is an indication of the acceptance of an objective.
- Who has to represent the interests? Concerning the internal acceptance this refers mainly to representativeness. Concerning external acceptance this concerns the acceptance by other organisations (Berkers a.o., 1996). A Dutch example of external acceptance concerns the organisation *Natuurmonumenten.* In former times *Natuurmonumenten* had a defensive attitude and this led to resistance towards their objectives with other parties. By developing a more constructive attitude, the acceptance has grown and *Natuurmonumenten* is now an important stakeholder in a lot of policy-making processes[6]. Another aspect of the representative is the capacity. This subject is discussed within the resource performance skills

Not only organisations but also projects can be legitimate. In this matter internal and external refers to participants and actors excluded from participation.

***Knowledge***

Knowledge is not the same as information. Knowledge is a personal interpretation of observations. When actors share this knowledge it becomes information. When not all actors have the same information to their disposal, information becomes a resource (Voogd, 1995).

In this report two forms of knowledge are distinguished: technical and social knowledge. Technical knowledge concerns knowledge about the issue, which can both influence the way a problem is defined and the weighing of alternatives. When an actor has a greater amount of

[6] This information originates from the interviews that took place in the framework of the research “Puzzelen met natuur, een casestudy rondom de totstandkoming van het conventant Herstelplan Naardermeer" (de Boer & Leene, 2000).

technical knowledge than other participants, he can exclude certain issues from the agenda or inform others only about those pro's and cons that make the alternative he most prefers look like the best alternative. Social knowledge concerns the knowledge about the characteristics of other participants. Social knowledge can be useful for developing relations with other actors that have corresponding interests, but also in manipulating actors with conflicting interests.

In the process of sharing knowledge and creating information, three kinds of problems can occur:

- People categorise the same information in a different way.
- Participants judge the information on its sender.
- Participants use a different vocabulary, which leads to a different interpretation (van Woerkum, 1995).

***Networks***

As described actors are related to each other through interdependency. When actors have contacts with each other in order to realise their (individual) objectives, these relations become networks.

Networks can be divided in formal and informal networks (Voogd, 1995). Formal networks are based on professional forms of co-operation between a number of actors. One of the main characteristics of formal networks is that they are "visible" and can therefore be reconstructed by a third party. Less visible are informal networks. Informal networks are formed by a number of actors that have more contact with each other than professionally required. Important bases for informal networks are individual contacts. These can originate from earlier co-operations but also from non-professional relations, for instance membership of a golf club.

When certain participants of a decision-making process are part of the same informal network, this can influence the final outcome. Certain information can be kept within a network and they can form alliances. Another possible influence is, when members of a network are also involved with each other outside the project, package-deals can be constructed in which interests concerning the project are exchanged with interest that are not related to this project.

***Performance skills***

Performance skills are affected by the ability to deploy other resources and include communication skills, organising skills, interpersonal skills like negotiation and mediation and strategic skills. Furthermore, also a sense of timing is of importance: when to remind others of the rules of the game and when to propose issues (Kaufman, 1995). Performance skills are a characteristic of the representative and not so much of an organisation.

In large organisations, professionals are often employed that are trained in these skills. Smaller (often self- and principle-interest) organisations are often dependent on the skills of their members. When these skills are less than the ones of other parties, this will decrease their possible influence on the project.

### *Best Alternative To A Negotiated Agreement (BATNA)*

The BATNA is based on the proposition that the only reason for negotiating is to obtain better results than can be obtained by other means, and that both parties will and should assess the likely outcome of the negotiations against their "Best Alternative to a Negotiated Agreement" (Sidaway & van der Voet, 1993). This definition implicates that the alternative depends on the other recourses that the actor has to its disposal. The better the alternative is, the less dependent an actor is on reaching an agreement. When the outcomes of the project are to a large extent dependent on the resources of this actor, but the actor has a good alternative (thus less dependence), he has a powerful position in the process. The BATNA is only of influence on the process of preparing actions and not on the implementation phase.

Within the policy arena each actor takes a position. The position of this actor is mainly based on the resources of an actor to influence the outcomes and the interests of an actor (and the impact the outcomes will have on these interests). The followings position or roles can be distinguished: initiators, supporters, adjusters, commentators, selectors, intermediaries and mediators.

## 2.6 Interaction processes between actors

### *Interaction processes: decision-making processes*

Influences of the social organisation on the spatial organisation are driven by processes in the institutional system. Actors try to realise their objectives or protect their interests by assessing their resources of influence, and therefore influence others or the spatial organisation. Actors assess their resources when they signal an unwanted situation that they define as a problem. In order to solve this problem a decision-making process will be initiated in which the problem will be defined and structured, alternatives are developed, compared and selected, uncertainties are pointed out and finally the best solution will be chosen. This process is referred to as the decision making process.

A more elaborated description of processes and phases in decision-making processes is given in annex 3.

The number of actors involved in a decision-making process depends on the structure of the problem. In policy problems three classes of problem structures are distinguished (figure 4): ill-structured problems, moderately structured problems and well-structured problems.

| | STRUCTURE OF THE PROBLEM | | |
|---|---|---|---|
| | *Well structured* | *Moderately structured* | *Ill-structured* |
| *Decision-makers(s)* | One or few | One or few | Many |
| *Alternatives* | Limited | Limited | Unlimited |
| *Values* | Concencus | Concencus | Conflict |
| *Outcomes* | Certainty or risk | Uncertainty | Unknown |
| *Probabilities* | Incalculable | Incalculable | Incalculable |

*Figure 4 : Differences in the structure of three classes of policy problems*
*Source: Mitroff & Sagaste in: Geurets & Vennix, 1989*

Many important policy problems are ill structured (Ackoff, 1974). Ill-structured policy problems are characterised by a large number of decision-makers, a large number of possible solutions called alternatives. What the consequences of these possible solutions are is uncertain as well as the risk that this consequence will occur. When the characteristics off ill-structured problems are compared to those of complex problems (chapter 1) there are a large number of correspondences. Therefore, ill-structured problems will be referred to as complex problems. Spatial problems are often complex problems.

***The need for participation***

Participation is not the right method for solving all problems. It is mainly suited for solving ill-structured or complex problems. Participation can refer to involving only the official decision-makers, because the initiator has no competencies to decide on his own. The initiator of decision-making processes can however also decide to involve more actors. Therefore a number of reasons can be distinguished.

The responsibility of the spatial organisation is divided over a large number of governmental organisations, there are often a large number of governmental organisations involved in decision-making. Furthermore, changes in the spatial organisation influence also a large number of non-governmental actors. These actors on their turn are not puppets on a string and therefore will react on changes (Teisman, 1998). When new policy has negative influence on their interests this will lead to resistance. The success of this resistance depends on the means they have to their disposal. In order to reduce the resistance the government involves actors in the decision-making process.

Practice has shown that traditional forms of involving actors in decision-making and policy development, in which stakeholders can react on the concept version of a plan designed by the government, are not effective. It has led to decisions that are not accepted by stakeholders and therefore to problems during the implementation. One of the possible solutions is an earlier involvement of stakeholders. This will not only decrease the problem in the implementation phase but also increase the commitment to decision. This concept is referred to as participative policy-development (de Lange, 1999).

A second reason for participation, besides less problems during the implementation, is to improve the quality of the decision (de Lange, 1999). Although a government is should be representative for all groups in society, actors can formulate their own problems better than the policy-developer and have information to their disposal that can lead to new and creative alternatives. Related to the need for high-quality policy is the concept of competitive-policy, developed by Teisman (1999). As a result of modern infrastructure, people and companies have become footloose. They are free to settle where the (physical and formal) conditions for settlement are best. This development has led to a situation where functional but also territorial units have to compete with each other, in order to create the best settlement conditions. This is called competitive-policy. In the process of improving the quality of an area, the government has to realise that their view on the concept quality can differ from the view of actors. As well in the process of defining the concept quality as in the process of developing this quality, the means and knowledge of stakeholders are of great importance. But they will only be willing to use them

when their contribution to the process is taken serious and has a positive result. Furthermore, the government has the task to attend to those interests that are not represented.

Decision-makers often criticise public involvement as a time-consuming process, which reduces the efficiency of decision-making. Figure 5 points out that this criticism may not be valid if the time taken to implement a decision is taken into account. Without public involvement the initial decision may be taken more rapidly, but if the outcome is unacceptable there may be a prolonged period in which the decision is contested and implementation is delayed. With public involvement it may take more time to come to a decision. But if the decision is acceptable to the interest groups, implementation should be assured and the total process will be shorter that under the original procedure (Sidaway & v.d. Voet, 1993).

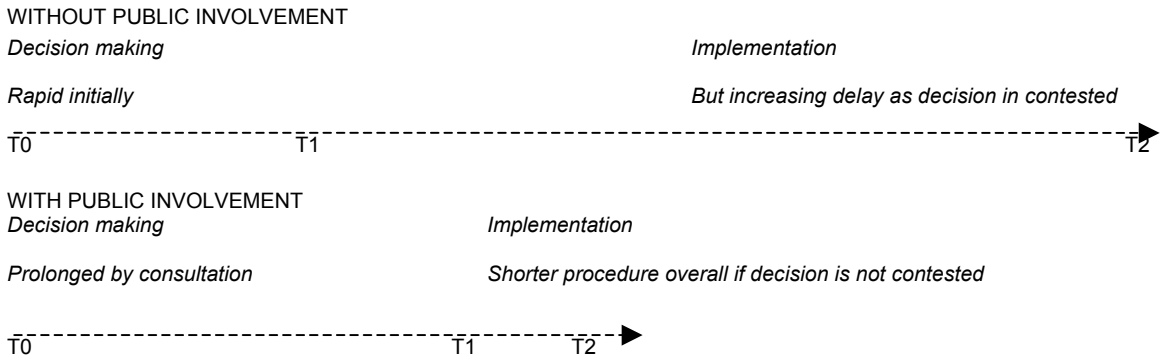



*Figure 5: Time taken to implement decisions by different forms of public participation*

*(Source: Delli Priscoli in: Sidaway & v.d. Voet, 1993)*

### *Forms of participation*

Within the concept participative policy development and decision-making a number of sub-forms can be distinguished. In this matter the participation ladder has been developed,. In this ladder six forms of participation are distinguished with each a different degree of participation and a different number of participants (figure 6). The degree of participation in figure 6 is defined as the extent in which participants can influence the final outcome of the decision-making process.

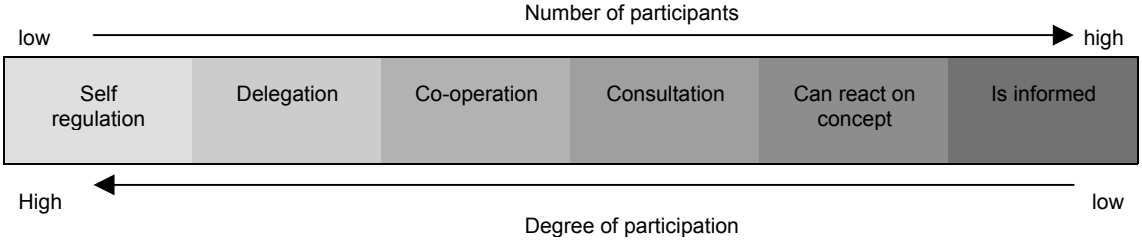



*Figure 6: Participation ladder*

*(Source: de Lange, 1999)*

Informing is not a real form of participative policy development. It is a one-way-traffic from the policy developer to the interested parties. The second form in which participants can react on a concept is a form of symbolic participation, because there is no guarantee that the policy developer will take the reactions into account. The same goes for consultation. The difference between consultation and reaction is that the first refers to an active approach from the policy developer, while the second depends on the initiative of the participants. In all these forms the policy developer makes the decision. In co-operation the different involved parties develop the policy together. In delegation the interacting organisations create a new organisation that is responsible- within an in front developed set of rules- for developing the policy (Teisman, 1998). Self-regulation means that all (governmental) tasks are placed under the authority of one of the organisation, and there are no demands from above on how the policy should be developed.

In most forms of participative policy development concerning the spatial organisation, the government chooses to involve different groups of actors in different ways. Together, these forms of formal involvement can be interpreted as the formal decision-making process. Besides the formal decision-making process also non-involved actors can try to influence the process. This influence, formal decision-making process and informal processes that take place form together the decision-making process.

***Participants and organisation-structure***

The actors that are of importance for solving a problem because they have resources that are needed for realising the solution, or because they can frustrate implementation can be interpreted as influential (de Groot, 1998). When these groups are consulted or just can react, and they do not see their remarks in the outcomes, the chance of non-acceptance will increase. Therefore a more intense form of participation like co-operation leads to a more sustainable outcome.

Some actors are not able to influence the process but should be involved because they are of importance. Importance refers to the priority given to satisfying the needs of these actors by the initiators of the project (de Groot, 1998). For instance, in ODA-projects women are often considered as an important group but have no influence. In order to reduce the complexity of decision-making the interests of these groups can be implemented by other forms of participation, for instance consulting.

Within the group of co-operating actors a distinction can be made through the organisation-structure. When the number of actors is too large to make decisions, or not all actors have the same (decision-making) rights, a project structure can be designed with sub-groups in which one group has the final decision-making rights. Concerning spatial issues this is often a group with only governmental organisations.

The more an actor is involved influences the weight their interests has in the final decision and therefore the final influence on the spatial structure.

***Participation and representatives***

Participation of influential and important actors does not guarantee a good representation of interests. One of the most important aspects is that representatives should be indeed representative for all members of an organisation. When this is not the case, there can be a matter of alienation of the group what can lead to non-acceptance of the group represented (Frouws in: van Woerkum, 1997). There are three factors that influence the way an actor is represented. The first is the extent in which the representative is present during the process. For smaller organisation, dependent on volunteers, this can become a problem. The second factor is mandate: authorisation of representatives to take binding decisions during the process (Glasbergen, 1991). The third factor is performance skills.

***Decision-making processes: forms of negotiation***

The decision-making process itself can be interpreted as a process of negotiation between two ore more actors. There are two forms of negotiation: distributive negotiation and integrative negotiation. Both are ideal-forms and form the ends of a continuum (van Woerkum, 1997). The characteristics of both forms of negotiation are reflected in figure 7.

| *Distributive negotiation* | *Integrative negotiation* |
|---|---|
| Starts from positions and needs. | Starts from an interest or a vision. |
| Hidden agenda's. | Open agenda's. |
| No joint fact finding. | Joint fact finding. |
| Over demanding. | No over demanding. |
| Threats. | No threats. |
| Less chance on a future relation. | Chance on a future relation. |
| Little learning effects. | Learning effects. |
| Little taking care of the (needs of) other. | Taking care of the (needs of) the other. |

*Figure 7: Distributive and integrative negotiation*
*Source: Van Woerkum, 1997*

In integrative negotiation participants often formulate a common problem definition that is accepted by all participants. In the process of defining a common problem actors are willing to reframe the problem and discuss their own ideas and beliefs. This leads to a process of joint fact finding in which common beliefs and ideas are formulated.

The need for problem acceptance and a common problem definition (the causes are discussed annex 3) derives from the need of commitment to the decision making process. In order to prevent frustration during implementation it is of importance that all actors that are of importance for the project have a gain in finding a solution. Therefore, their personal objectives should be represented in the objective of the negotiation and be placed on the agenda.

When there is non-acceptance of the problem participants still have their own problem definition. In this matter changes (in the institutional or physical system) can lead to another BATNA and important actors will no longer co-operate and resist to implementation of the outcome.

The outcomes of integrative negotiation are interpreted as more sustainable than those of distributive negotiation. In distributive negotiation actors only take their own problems and needs into account and over-demand. The outcomes seldom fulfil these demands and therefore participants are often disappointed. Furthermore, changes can lead to a situation that the

disadvantages of the compromise take overhand over the advantages, and the participant will no longer support the outcomes.

***External audits***

An audit is the inspection of the organisation or functioning of a company. Audits can focus on different elements of an organisation: financial audits, operational audits, internal audits, and technical audits, etceteras (Geerts & Den Boon, 1999).

When actors involved in a decision-making process are interpreted as an organisation, this organisation is not isolated from its environment. Developments from outside of the process can influence the decision-making process. These developments are referred to as external audits.

External audits can not or be little influenced by participants of the process. On the other hand external audits can influence the process. Different authors categorise external audits in different ways. The most mentioned are technological developments, financial developments and developments in policy (Voogd, 1995). External audits can have both negative as positive effects on the (outcomes of the) decision-making process. Opposite of external audits are internal audits that come from within the organisation.

## 2.7 Synthesis

Changes in the discharge capacity of rivers can be interpreted as changes in the spatial organisation, which result of physical processes and social processes. Social processes are driven by processes in the institutional system: actors, their interests, the resources that they assess to realise these interests and the interaction between these actors.

Changes in the spatial organisation are often preceded by group- or individual-decisions, made in the institutional system. Because spatial problems are often ill-structured or complex problems, a large number of decision-makers is involved. Therefore, the initiator in the decision-making process (often the government) needs to involve other actors that are influential or important for the process, because they can contribute to the quality of the outcome or they are important for successful implementation. There are different degrees of participation. Within a process different actors can have a different degree of participation. This is reflected in the organisation structure.

The decision-making process is not only the formal process but also the processes outside the formal process (the informal process) that influences the actors and their behaviour in the formal process.

The outcome of the decision-making process depends on:

- The characteristics of participants
- The nature of decision-making processes.

Characteristics of actors or participants are:

- Interests, objectives and attitudes

- Resources of influence: power, legitimacy, knowledge, networks and performance-skills.

The nature of the decision-making process can vary for integrative negotiation to distributive negotiation. Integrative starts with a common problem definition and leads to a more sustainable outcome (less sensitive for changes in the environment). Distributive negotiation does not start with a common problem definition which leads to less commitment in the process and therefore less chance on a(n) (sustainable) agreement.

The decision-making process can also be influenced by external audits: developments that influence the process but can not or little be influenced by the participants themselves.

# 3. Analytical framework

## 3.1 Introduction

This chapter demarcates the objective of this research and translates this into the problem definition. The problem definition is reflected in an analytical model that reflects the different elements and their relations. Relating to this model, research questions are formulated. Furthermore it describes the methods used in this research and the structure of the case study description.

The concepts and definitions used in this chapter are explained in chapter 2.

## 3.2 Objective, demarcation, problem definition and research questions

***Objective***

In the beginning of this research the background of this research has been translated in the following objective.

> *Gaining insights in the developments in the German river and floodplain management on a regional level, showing the links between natural processes, spatial planning, engineering interventions, river functions and stakeholder interests, in order to identify which elements and relations are the driving forces in the development of the discharges of the Rhine and therefore should be represented in STORM, and compare the outcomes of this case study to the design of STORM.*

As discussed in the theoretical framework, developments of the discharge capacity of the Rhine depend on the spatial organisation of the river and the (former) floodplains. As described in the theoretical framework, changes in the spatial organisation are the result of the processes in and interaction between two organisations,

- The physical organisation, driven by the natural processes and influenced by human interventions.
- The social organisation, driven by processes in the institutional system: the interaction between actors.

The interaction between actors (the institutional system) depends on their objectives, interests, attitudes and resources of influence to realise their objectives. In complex spatial issues interaction partly takes place in formal decision-making processes. These processes are often initiated by the government there spatial organisation is a governmental task. In this matter the process organisation and representation of actors in this process influence the outcome. This means developments in the institutional system (and therefore the developments in the spatial organisation). Second informal processes influence the formal decision-making process (and therefore social organisation and the spatial organisation). Together, these processes are called the decision-making process (also called interaction process). Besides “participants” also the

nature of the negotiation in the decision-making process influences the outcome. Furthermore external audits can influence the outcome of the process.

The spatial organisation also influences the institutional system. Situations or developments that differ from objectives of actors occur as a problem: unrealised values, needs or opportunities that may be attained through action. Which action an actor takes depends on his resources of influence and the interdependency on other actors. Each action (group or individual) is proceeded by a decision-making process. Through the action the spatial organisation changes and other actors may be influenced.

This has been reflected in figure 8.

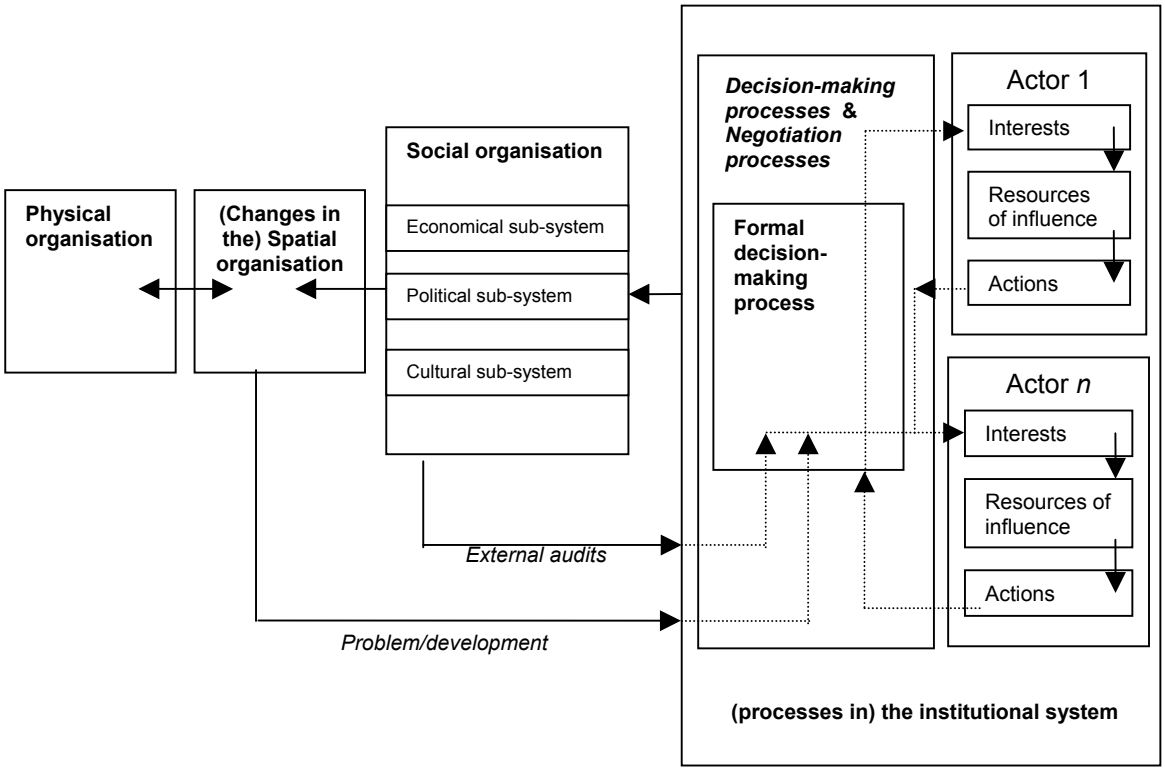



*Figure 8: changes in the spatial organisation*

### *Demarcation*

Because there is already information concerning the dynamics in the physical system this research will focus on the dynamics in the institutional system. Therefore, the processes in the physical system will only be discussed when they are of importance for explaining the dynamics in the institutional system and/or social organisation.

Furthermore, this research will only discuss the processes on a regional scale. As discussed in the introduction, the representativeness of the regional decision-making for national processes are discussed in another report of STORM.

***Problem definition***

The above has been translated in the following problem definition.

> *How do the characteristics of the actors in the institutional system and the processes between these actors influence the spatial organisation regarding the discharge capacity of the Rhine, how does the social organisation and spatial organisation trigger these processes, and is STORM capable of simulating these characteristics and processes?*

***Research questions***

The problem definition has been translated in research questions[7]

1. *How is the spatial organisation of the Rhine constructed in the case study area?*

2. *How is the German institutional system regarding river management of the Rhine in the case study area constructed, which actors are involved, what are their characteristics and how are they related to one and another?*

3. *Which elements are the driving forces behind the processes in the institutional system and therefore behind the influence of the social organisation on the spatial organisation?*
   a. *Was the decision-making process more integrative or distributive, and what was the influence of the nature of the decision-making process on the outcome therefore on the spatial organisation?*
   b. *How did the processes in the formal decision-making process and informal decision-making process influence one and another, and what was the influence on the outcome and therefore on the spatial organisation?*
   c. *How are processes in the institutional system influenced by the characteristics and resources of actors?*
   d. *How are the processes in the institutional system triggered or influenced by developments in the spatial system?*
   e. *How are processes in the institutional system triggered or influenced by external audits?*

4. *Based on the above questions: How do the characteristics of the actors in the institutional system and the processes between these actors influence the spatial organisation regarding the discharge capacity of the Rhine, how does the social organisation and spatial organisation trigger these processes?*

5. *How is STORM constructed and is STORM capable of simulating the characteristics of and processes in and between the spatial and institutional system?*

[7] All definitions and concepts used in the research-questions are defined in the theoretical framework.

## 3.3 Methods

***German river management***

In order to reach the above objective and answer the research questions a case study concerning river management on a regional scale has been conducted. In the framework of the objective of this research a section of the Rhine between Worms and Mainz has been selected for the case study. The selection of this area is based on contacts at the beginning of this project with Förderverein Umweltmediation (an organisation is involved with facilitating the development of water quantity policy in this area) and the Institute for Wasserversorgung, Abwassertechnik, Abfaltechnik & Umwelt und Raumplanung of the Technische Universität Darmstadt, which is located in the same area. The outcomes of this case study will give insights in the driving forces behind changes in the river and floodplain management and therefore in the discharge of the Rhine.

In order to gain insights in the complexity of the German system first an inventory has been made of organisations that have interests conflicting of corresponding with river management and organisations that are authorised to make decisions that influence river management. This information has been gathered by studying map material, visiting the area and making a literature analysis of the administrative system.

Based on the above analysis different governmental organisations and interest parties have been interviewed. Starting point for selecting the organisations related to certain interests was a list of organisations that participated in the enforcement of a municipal expansion plan along the Rhine. In this matter it was difficult to judge if certain organisations were representative. However, most organisations that were contacted were able to judge if they found themselves the right organisation to help us, or if another organisation (regarding the same interest) would provide more useful information for the research. An overview of the interviewed organisations is given in chapter 11.

For the selection of the local interests two municipalities were selected in which a decision-making process concerning high water protection measures took place: The Ried (Hessen) and Mainz-Laubenheim (Rheinland-Pfalz).

Within the interviews open questions were asked regarding the subjects:

- Organisation
- Interests and attitudes
  - General interests
  - Regarding the spatial organisation of the cross-section of the Rhine and the former floodplains.
  - Regarding safety and discharge capacity
- Resources of influence
- Participation in decision-making processes.
- Opinion about the interaction in and outcome of these processes.

Based on the interviews, literature about the German institutional system and governmental (policy) reports, a reconstruction has been made concerning the decision-making processes on concerning German water-management on a regional scale.

***Comparison to STORM***

The outcomes of the case study have been compared to the design of STORM. This comparison will be made on the elements:

- Spatial organisation and it's influence on the institutional system.
- The characteristics of the actors institutional system and it's influence on the processes in the institutional system.
- The processes in the institutional system and their impact on the spatial organisation.

Based on this comparison conclusions can be drawn about the representativeness of STORM for simulating river management. Furthermore, recommendations will be made about the application of STORM in river management decision-making processes.

## 3.4 The case study

In the following chapters the German regional processes in river management will be analysed. Therefore, first a description of the spatial organisation will be given (chapter 4). The description of the institutional system has been divided over the socio-economic system (chapter 5) and the administrative system (chapter 6). After these elements have been described the processes in the institutional system and the influence of the spatial organisation on these processes are discussed (chapter 7). Based on these descriptions and discussions, conclusions concerning the case study will be drawn (chapter 8).

The driving forces in German river management on a regional scale (conclusions in chapter 8) will be compared on the design and functioning of STORM. In this chapter also the general conclusion will be drawn.

# 4. Introduction to the case study area

## 4.1 Introduction

This chapter gives a description of the location, spatial structure and assets in the case study area. The objective of this research is to give insights in how the spatial organisation of the Rhine is constructed in the case study area. This relates to research question 1.

This chapter is constructed of five sections. Section 1 gives a general description. Section two gives a description of the hydrological characteristics, section three describes the spatial structure and section four describes the assets. In section five contains the synthesis.

## 4.2 The Rhine and the case study area

The Rhine is an international river that runs through four European countries: Switzerland, France, Germany and the Netherlands. The total length from the Swiss glaciers to Hoek van Holland is 1.320 km. The catchment area is spread over nine countries and has a total ground surface of 185,000 km2. The largest part of this area is located in Germany (ca. 100,000 km2) (WWW.ISKR.de). The Rhine is sub-divided in four sections, and each has it's own hydrological and morphological characteristics: the Alpine Rhine, the Upper Rhine, the Middle Rhine and the Rhine Delta.

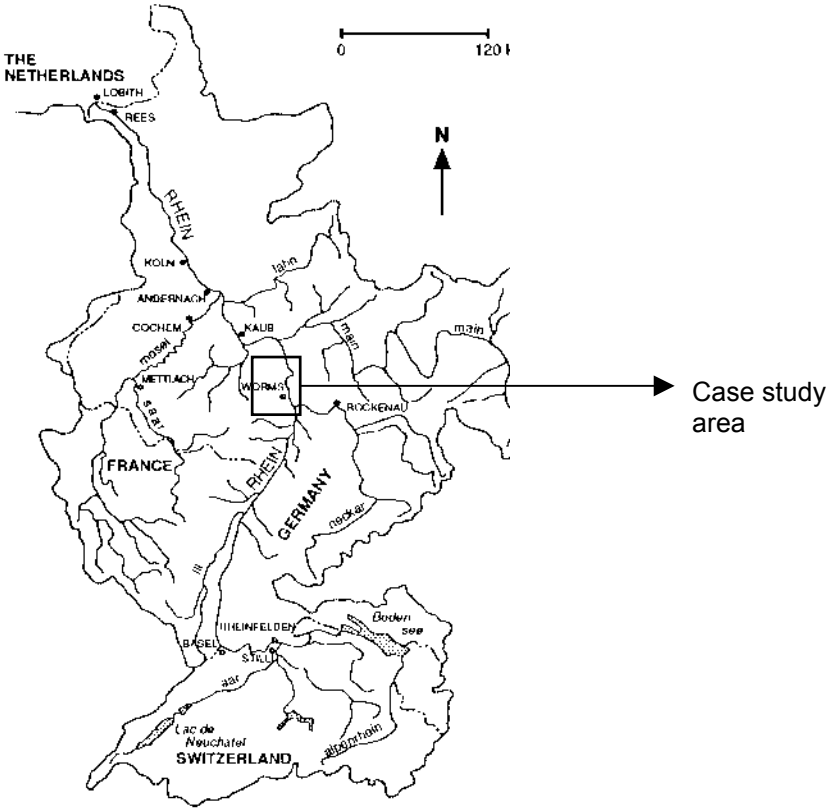



*Figure 9: The Rhine drainage basin upstream of Lobith*
*Source: Kwadijk, 1993*

The case study area is a part of the upper Rhine, which runs from Basel to Bingen (figure 9). It concerns the section of approximately 80 kilometres that is located in the Rhine-Main-Neckar region, between Worms and Mainz, and will be referred to as the case study area (figure 10). Worms is situated downstream where the river Neckar flows into the Rhine. Mainz is located opposite of the confluence of the Main. Between these two cities, there are no major tributaries that flow into the Rhine and therefore influence the discharge thereof.

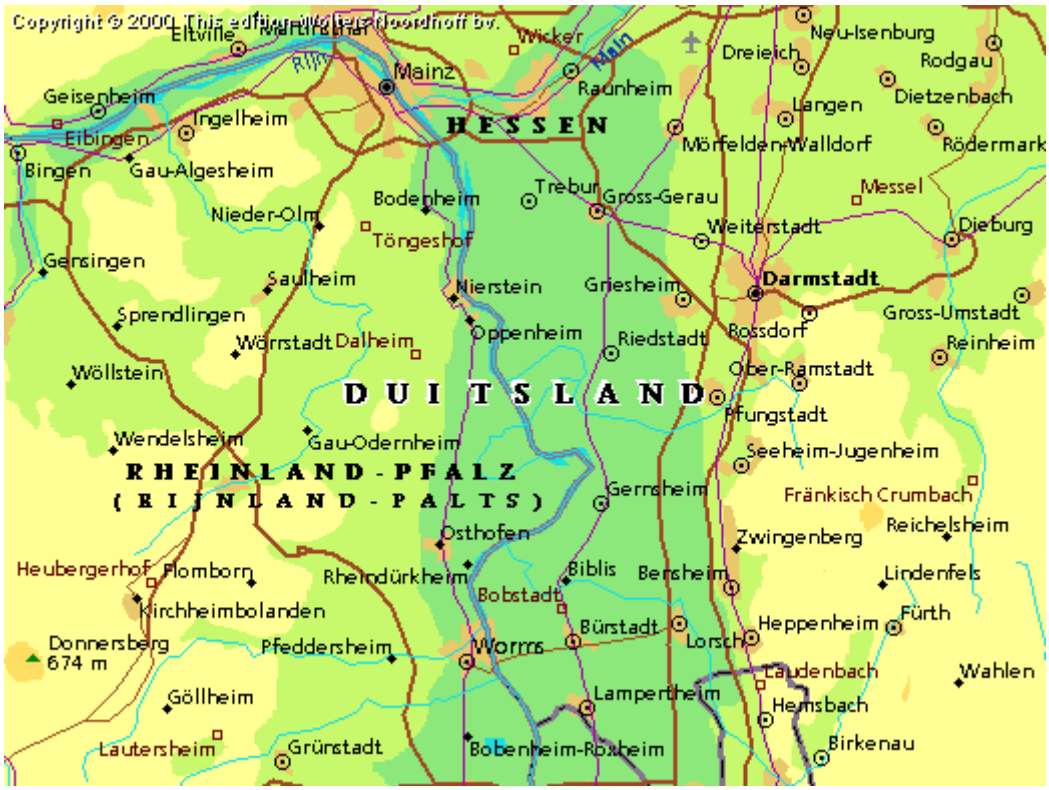



*Figure 10: the case study area.*

### 4.3 Hydrological characteristics

The different parts of the Rhine have different hydrological characteristics. The alpine Rhine (above Basel) is characterised by high discharges during the summer. Further downstream, in the section between Basel and Worms, both winter *and* summer are characterised by high discharges. Downstream of Worms, the winter floods become higher than the summer floods (Ministerium für Umwelt und Forsten Rheinland-Pfalz, 1998). The differences in discharge levels along the Rhine are reflected in figure 11.

These differences are caused by the different sources that feed the Rhine. Upstream of Basel the river is governed by a snow-melt regime, with a pronounced maximum in the summer. This maximum discharge is the result of two factors: the melting of the snow during late spring and early summer, and a summer precipitation maximum caused by convection due to the blocking of north-westerly airflow. Downstream of Basel a pluvial regime dominates, with a distinct winter maximum. Low runoff rates from the middle and lowland area during summer result from the evapotranspiration surplus during this period, in spite of the summer precipitation maximum

(Kwadijk, 1993). As the Rhine flows further downstream, the catchment area increases due to the side-rivers that join the Rhine. Therefore, the water supply of the Rhine increases as well.

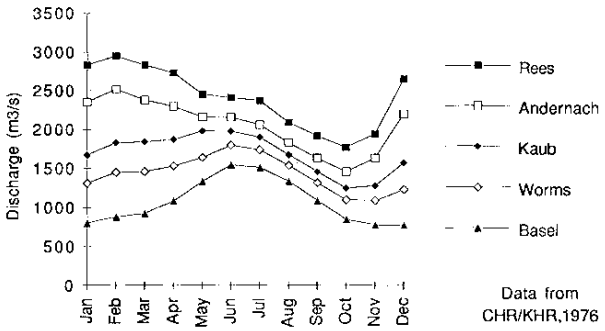
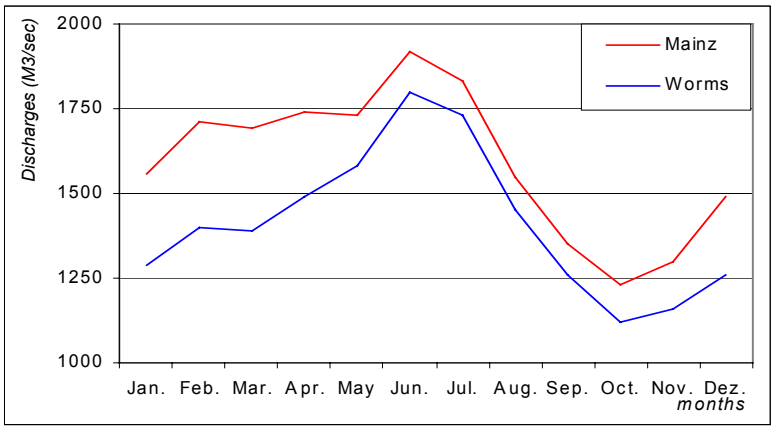



*Figure 11: hydrograph for several gauging stations along the river Rhine.*

*Source: Kwadijk, 1993*

As described in the beginning of this section, the upper Rhine is characterised by higher discharges during winter than during summer. In figure 12, the average (calculated over the years 1930-1996) monthly discharges are reflected for the measure points at Worms and Mainz. Both lines indicate that the average discharge during the summer months is higher than during the winter months. The difference between the discharges of Mainz and Worms results forms the position of the measure point Mainz, being downstream of the point where the river Main joins the Rhine. The figure is based on the discharges given in the "Deutsches Gewässerkundliche Jahrbuch".




| | Mainz | Worms |
|---|---|---|
| Jan. | 1560 | 1290 |
| Feb. | 1710 | 1400 |
| Mar. | 1690 | 1390 |
| Apr. | 1740 | 1490 |
| May | 1730 | 1580 |
| Jun. | 1920 | 1800 |
| Jul. | 1830 | 1730 |
| Aug. | 1550 | 1450 |
| Sep. | 1350 | 1260 |
| Oct. | 1230 | 1120 |
| Nov. | 1300 | 1160 |
| Dec. | 1490 | 1260 |

*Figure 12: Hydrographs of Worms and Mainz over the Years 1936 until 1996*

The average monthly discharges are the result of fluctuations of the discharges during the months. During winter months, these fluctuations are much larger, with a relative low discharge and a peak, which lasts approximately ten days and has a discharge for approximately 4000 m3/sec. During summer there is a relative constant discharge throughout the entire month. Therefore, the high water threat during winter is higher than during summer. The high water protection measures have therefore been designed to protect against the winter peaks.

## 4.4 The spatial structure of the case study area

The Rhine in the case study area is a meandering river. This meandering stops downstream of Mainz, where the hydrological gradient decreases, and sedimentation starts taking place. This leads to a process of formation, shift and disappearing of riverbanks within the Rhine. Because these banks, which are positioned in the middle of the Rhine, this area is referred to as the island-Rhine (Herr Egeling, NABU). This area falls out of the scope of this research, but the conservation of this process is relevant for the interests of the NABU in the case study area.

The landscape that surrounds the Rhine area can be characterised as a valley. The form of the valley stands in contrast to the landscape of the Middle (island) Rhine, where the river is for the greater part surrounded by (stone) mountains. In the river valley of the Rhine in the case study there are a number of kilometres of open alluvial grounds that separate the mountains from the river. On the Hessian side of the Rhine the open space between the river and the mountains (*Bergstrasse*) is larger than on the Rheinland-Pfalz side. This is partly caused by the former river structure that had a wide riverbed and covered a large part of this area. Furthermore, the riverbed of the Neckar was until a number of centuries ago situated in this area. Compared to its present position, the Neckar joined the Rhine approximately 60 kilometres downstream of its present position.

To enable the use of alluvial areas for agriculture and other purposes, to improve shipping conditions and to reduce the risk of the formation of ice-walls in winter, the course of the river was drastically changed in the 19$^{th}$ and 20$^{th}$ century. The length of the river between Basel and the border of Hessen was reduced by almost 20% (Riza, 2000) As a result from these measures, a number of old river arms (meanders) were (partly) cut of from the Rhine. In the case study area there are only a small number of such old river arms (compared to the upstream areas). The largest old Rhine arm in the case study area is the Altrhein, which is still connected to the Rhine.

The floodplains of the Rhine in the case study area are relatively wide. The ground surface of these floodplains has changed little since the beginning of this century, and the winter dykes are still in the same position (Ministerium für Umwelt und Forsten Rheinland-Pfalz, 1998). One of the few modifications in the floodplains is the settlement of industrial companies that led to a small decrease of the ground surface thereof. Since 1968, construction is prohibited in the floodplains[8]. These companies are dependent on the water of the Rhine or on the possibilities of water linked transport (cooling water for power plants, access to inland navigation).

In contrast to most other areas in Germany, the floodplains in the case study area are equipped with summer dykes, which differ one meter in height from the winter dykes. The summer dykes protect the winter polder (the area between the summer and the winter dyke) against floods that have a repeating chance of 3 years. The winter polder is mainly used for agriculture and nature protection. Furthermore the floodplains have an important recreational function for the people living in the area. The main form of recreation is extensive (walking, biking) and focussed on nature and landscape. Furthermore, there are some temporary camping sites that are only used in times of low water and are removed during winter (high water).

[8] In certain cases the government can decide to make an exemption to this rule.

## 4.5 Assets in the case study area

### *Nature*

In the case study area a number of valuable nature protection areas are situated. On the Hessian side this concerns (amongst others) the Kühkopf-Knoblochsaue, the largest floodplain-nature protection area of Mid-Europe (ca 2369 ha) (European Bird Protection Area) and the Lampertheimer Altrhein (525 ha) (Dister a.o., 1990). Both nature protection areas are located in old river arms. On the Rheinland-Pfalz side there are nature protection areas in the floodplains near Nackenheim, Oppenheim and Hamm. All the above nature protection areas are located in front of the winter dyke and are for the largest part ruled by the flooding regime of the Rhine (Dister a.o., 1990). This leads to a marginal vegetation in which the presence of species is the result of the different gradients in the area.

There are also nature protection areas situated behind the winter dyke. These are mainly forests located on higher areas in a long distance from the river (Ministerium für Umwelt und Forsten Rheinland Pfalz, 1998), and therefore not relevant for this research.

### *Agriculture*

The agricultural situation in the case study area has been going through various changes within the last two decades. Today, as a result of the more austere legislation from the European government concerning the milk quota and manure use issues, the land use has changed from pasture to other forms of agriculture (Land Hessen, 1999). In the present situation the most important form of agriculture in the alluvial areas is the cultivation of full ground vegetables, for example asparagus and sugar beets. In the higher areas, on the mountainsides of the Bergstrasse, the ground is used for viticulture.

Due to the development of housing areas, industries and nature protection areas the percentage of ground surface that is used for agriculture has changed. Within the Ried, it has decreased 12.5 % within the past 18 years (ARLL, 2000). At present, 70% of the ground surface in the Ried is used for agriculture (interview gemeinde Riedstadt).

### *Economy*

The economical growth in Germany is in a decline. As result from the unification from East and West Germany, a large part of the taxes are invested in the eastern part while the unemployment (and therefore the total of tax-incomes) has increased. The main effect of this on the case study area is an increased unemployment and financial problems with companies. However, compared to other German areas the effects are relatively small. This is mainly the consequence of the presence of Frankfurt as a German and European centre for business and commerce, which is of great economical significance for both the region as the entire of Germany. In order to comply with the need from investors and multinationals, Frankfurt International Airport is now expanding with the construction of a fifth runway. The effect of this on the rural areas is that the ground-prices in the neighbourhood of the airport increase (IHK)

and therefore industries that are less dependent on the airport but need a large ground surface, settle in the more rural areas.

In the rural area a number of industrial settlement areas, which are mainly used for ground consuming industries, is located. Examples of these industries are the distribution centre of MITSUBISHI near Trebur and the OPEL industries in Rüsselsheim. These industries are not concentrated but are spread out over the region.

Concerning the Rhine-Main-Neckar Region, industries dependent on inland navigation are mainly situated at Mannheim and Ludwigshafen (upstream of the Neckar mouth). This location can be interpreted as strategic, because it does not only provide access to the other industrial areas along the Rhine but also to the industries that are located on the Neckar (e.g. AUDI in Neckarsulm; Porsche in Stuttgart). Within the case study area there is a harbour located in Gernsheim that is of less economic importance then the harbours of Mannheim and Ludwigshafen. However, for the case study area it plays an important role for the distribution of chemical products from the MERCK company in Darmstadt (950,000 t/a in 1999). Other inland harbours in the case study area are located in Worms (1,040,000 t/a) and Mainz (1,930,000 t/a) (Wasser- und Schifffahrtsdirektion Südwest, Verkehrsbericht 1999).

***Navigation***

In total the Upper Rhine (Iffezheim) was in 1999 responsible for the transport of 32.500 ships. For the river section between Worms and Mainz this number is be even higher, because the measure-point Iffezheim is located upstream of the Mannheim-harbour, the BASF (Ludwigshafen), which are both important transit points (see figure 13) and the river mouth of the Neckar. Almost all the navigation is used for the transport of goods. In the upstream direction this is mainly for the transport of mineral products and mineral waste materials. In the downstream direction this is mainly for the transport of construction materials (Verkehrsbericht 1999).

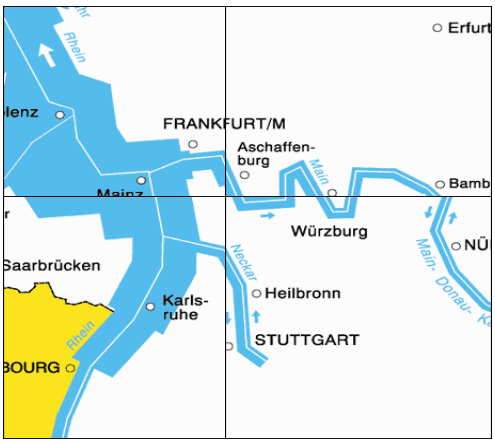



*Figure 13: shipping movements on the Rhine*
*Source: WWW.WSV.de*

***Housing***

In the case study area there are a number of towns with a small number of inhabitants like Oppenheim, Nierstein, Mainz-Laubenheim and Gernsheim. These towns have approximaticly 10.000 inhabitants. Some of these small towns are located directly behind the winter dykes and have a high damage potential. Besides Mainz and Worms (Rheinland-Pfalz), there are no large cities in the case study area.

As a result from the expansion of Frankfurt Airport, the noise pollution in the rural district Groß-Gerrau (the Hessian side) will increase and in certain areas will not be suitable for housing areas. Therefore, it is expected that the need for housing areas near the river will increase.

***Water extraction***

On both sides of the Rhine groundwater extraction for drinking water takes place in the floodplains. As a result from a greater awareness of environmental problems, the need for drinking water decreased the last decade. Besides water distraction for drinking water, also water is distracted for agricultural purposes and industrial cooling water. This water is distracted from the Rhine and tributaries.

## 4.6 Synthesis

The case study area is a part of the upper Rhine, where high water peaks occur during winter. The area that is relevant from a discharge point of view is constructed of three physical elements with each their own hydrological characteristics: the river, the floodplains and the land behind the dikes.

Although the case study area is part of the most densely populated areas of Germany, the region itself has a more extensive land use. Except for the cities Worms and Mainz there are no large cities adjacent to the river, and the land-use is mainly agriculture. Furthermore, there are ecological valuable areas located in the floodplains of the Rhine, which are protected in the European policy.

# 5. The socio-economic system

## 5.1 Introduction

This chapter will describe the objectives, attitudes and means that relate to the different interests concerning ownership and land-use in the case study area, as discussed in the previous chapter. This relates to research question 2: how is the German institutional system regarding river management of the Rhine in the case study area constructed, which actors are involved, what are their characteristics and how are they related to one and another?

The following interest will be discussed: navigation (5.2), nature protection (5.3), agriculture (5.4) and local economy (5.4). The interests regarding housing and safety are represented by governmental organisations and therefore discussed in chapter 6. For each interests the organisation that is related to these interests, the objectives or attitudes and the resources of influence that these organisations have to their disposal. For each organisation also their relation with other actors will be described.

## 5.2 Navigation

### *Wasser und Schiffarhtsverwaltung*

The organisation that usually represents the interest of (recreational and professional) navigation within procedures, concerning first order waterways, is the Wasser und Schiffahts Verwaltung de Bundes (WSVB). The WSVB is the governmental organisation that is responsible for keeping federal waterways navigable and is sub-divided in several departments. The section of the Rhine in the case study area falls under the responsibility of the Wasser und Schiffahrtsamt Mannheim (WSAM), which is responsible for the Rhine section between Karlsruhe and Mainz. In this research there is no relevant distinction between both organisations. Therefore, it will be referred to as the WSV. The interests of the WSV correspond to a large extend to the interests of inland navigators, and can therefore be interpreted as representative. The governmental task of the WSV, as described in the navigation law, is subdivided in the optimising of the cross section of the Rhine and controlling navigation (*Schiffahrtspolizei*).

### *Interests and attitudes*

*Water level*

The possibilities for navigation on the Rhine are limited by maximum and minimum water levels. The minimum water level is set on 2.10 meters below the Gleichwertiger Wasserstand (GLW)[9]. When the water level is below GLW it is not allowed to navigate with a maximum load. The maximum water level is 6.50 +NAP meters for the section between Worms and Gernsheim and 6.30 m +NAP for the section from Gernsheim until Mainz. However, between the maximum and the minimum water level, there are also restrictions for Navigation. The amount of load that can be transported depends on the water level (Rheinschiffahrts-polizei-verodnnung; WSV). The

effect of limitations to transport loads is an increasing number of ships needed for the same transport. At the same time the river width decreases. More ships on the river lead to a lower speed and longer waits for locks, which results in a longer transport time and higher transport costs.

In 1999 the maximum water level in the case study area was exceeded for 33 days, of which 28 days in May and June. This value however is extremely high. More representative is the total amount of days that navigation was prohibited in the upper Rhine in the last ten years (1991-1999): 47 days (Interview WSV; Verkehrsbericht 1999).

*Sedimentation processes*
Within the Rhine sedimentation mainly takes place downstream of Mainz (Middle-Rhine) as a result from a decrease in water speed. In order to decrease the sedimentation in the Middle Rhine, the WSV has constructed a gap in the Rhine (downstream of Mainz), to catch a part of the sediment. This way local a decrease of the river depth that can become a danger for navigation can be prevented (interview WSV). One of the causes of a decrease of water speed is a local widening of the cross-section, for instance as a result from the construction of a side-channel. Because dredging is a very expensive solution, the WSV is not supportive to measures that cause sedimentation.

Another effect of side channels with a large discharge capacity is the generating of a side stream, which can influence the stability of ships. Especially for smaller, recreational ships this can cause danger. Not only the construction of side channels, but also the draining and extracting of large amounts of water can cause this effect.

*Paving of sand- and riverbanks*
In order to maintain a stable cross section river- and sandbanks should have a fixed location. Sandbanks have a natural process of formation, shift and disappearing and river banks have the risk of crumbling off. By paving sand- and riverbanks these processes are blocked. For the maintenance of the pavement, a road should be constructed along the riverbanks.

***Resources of influence***

The WSV is, concerning the development of the Rhine, an influential organisation. All federal waterways and their riverbanks, of which the Rhine is one, fall under the authority of the WSV. In this matter the formal responsibilities and instruments of the WSV have been arranged in the law. The most important concerning the discharge capacity of the Rhine is the right to make decisions or to participate in all procedures about all human interventions in the cross-sections of federal water ways and the right of participation in all changes of land-use that influence federal waterways. This will be further elaborated in the description of the institutional system.

Besides these formal instruments the WSV has also a less formal instrument. In decision-making processes they derive power from their status as national organisation. Also the economical decline is favourable for the interests of the WSV, since navigation on the Rhine is of great economical importance for Germany. Therefore, the interests of the WSV can be seen as legitimate.

[9] The GLW is based on the water level that is not exceeded for 20 days in a year (WSV)

***Relations***

The WSV has intensive contacts with the navigators. Of the other actors in the case study area their are contacts with the regional governments in the framework of licensing, but also in an informal way. In other procedures the WSV has contacts with other interests organisations, such as nature organisations. However, these contacts are mainly formal and do not lead to co-operation outside these processes.

## 5.3 Nature

***Organisations***

There are different non-governmental nature protection organisations that are active within the area. These organisations are active on a local scale but also on higher scales. The difference between the organisations is that they focus on different aspects of nature conservation, for instance ornithology or floodplain ecology. The objectives of the various nature protection organisations, concerning nature development within the floodplains correspond to a large extend with each other. One of the larger nature protection organisations is the Naturschutz Bund (NABU). This organisation is active on a national scale and has around 300.000 members in the entire Germany.

Non governmental nature protection organisations can acquire the status of a "recognised nature organisation"[10] based on section 29 of the federal nature conservation law. Recognised nature organisations have to be invited to participate in governmental processes that can influence nature development. The participation is restricted to representing their interests. They are not allowed to co-decide.

Besides non-governmental organisations also governmental organisations represent nature conservation interests. Dependent on the scale a process takes place the local, regional or federal nature conservation department represents these interests. These departments receive feedback from the non-governmental organisations.

***Interests and attitudes***

*Floodplains*
The main interest of nature conservation organisations is to restore the original ecosystem within the floodplains. The original vegetation exists out of various ecosystems that are related to the frequency of flooding. The original vegetation or marginal vegetation exists of softwoods on lower areas of the floodplain and hard woods on higher areas within the floodplain. The hard wood areas can endure a flooding for maximum for hundred days. Another part of the marginal vegetation is unpaved riverbanks, which create a natural transition to the water-ecology. The

[10] The German term for a recognised nature organisation is an *Anerkannte Verbande*. In order to receive this status an organisation has to comply with a number of conditions.

vegetation that will develop in the floodplains and on the riverbanks depends on the flooding frequency and the maintenance.

The summer dikes obstruct the natural flooding of the floodplains and therefore the return of marginal vegetation. It will be in the interest of nature conservation to remove the summer dikes or stop the maintenance of the summer dikes.

*River*

The slow flowing areas of the Rhine (mainly (former) Rhine arms) that are not disturbed by human activities are interesting for nature conservation. The shallow parts of these areas contain a lot of food and are therefore an important habitat for birds. Furthermore, when these areas are fully connected to the Rhine (on both sides) fishes can use them for spawning and habitats for juveniles (Interview Egeling; Mock a.o.).

Another interest of nature conservation organisations is the aim at restoring the natural process of formation, shift and disappearing of sandbanks within the Rhine. Although this process concerns more the area downstream of Mainz than the river section between Worms and Mainz, it is influenced by measures taken in the case study area.

In the framework of measures that lead to a change in discharge capacity, the nature organisations prefer the expansion of floodplains. This alternative is not a part of the political discussion because of the high costs and the resistance of agricultural organisations and local fears for ground water problems. Within the alternatives that are part of the political discussion they prefer an ecological controlled retention area.

***Resources of influence***

The nature protection organisations have little financial means to their disposal, and are therefore not able to develop their own nature protection areas. For this they are dependent on the government. As discussed above, non-governmental nature conservation organisations have contacts with the governmental departments. Governmental nature departments mainly represent the interests of nature, a situation that is seen by the ngo's as normal and therefore can be interpreted as a part of the German culture. This is also due to the little capacity of the organisation, which consists mainly of volunteers.

The right to react on concept policy, as being a recognised organisation, does not imply that nature interests are always taken into account. This is partly the consequence of the economical situation in Germany, that makes economical interest more legitimate than interests that restrict economical growth. Nature interests are interpreted as negative for economical growth (interview Egeling). Besides the right as a "recognised organisation" one of their most important instruments to influence governmental policy is through the media. By doing their own research they collect information about the current ecological situation. By making these data public they can influence public agenda's and discussions.

Finally, being a principle group can be seen as a resource of influence. The public and other participants react in another way on behaviour based on principles than on self-interests.

***Relations***

For realising their objectives, the nature organisations are dependent on governmental organisations. For the objectives concerning the floodplain these are the regional agricultural government, the regional water government and the local government. The regional water government has to allow all changes in land-use in the floodplains[11]. When there is a change, agricultural companies will have to be bought out or replaced. Furthermore the local government is responsible for the decision about maintaining the summer dike. For the objectives concerning the Rhine, the Nature organisations are mainly dependent on the WSAM.

## 5.4 Agriculture

***The organisation***

Farmers are organised in municipal organisations (*Ortsverbande*) and inter-municipal organisations (*Kreisverbande*). Furthermore there are organisations for the different forms of agriculture (pasture, viticulture, etc). The different organisations are joined in the regional agricultural committee (RAC) (*Gebietsagrarausschuß*) (see figure 14). These committees are related to the Departments for Regional Development, Landscape Maintenance and Agriculture that are a part of the regional government. On a higher level a Federal Agricultural Committee (FAC) (*Landesagrarausschuß*) has been formed. The task of the committees is to advise the government in issues concerning agriculture and represent the interests of agriculture within planing processes.

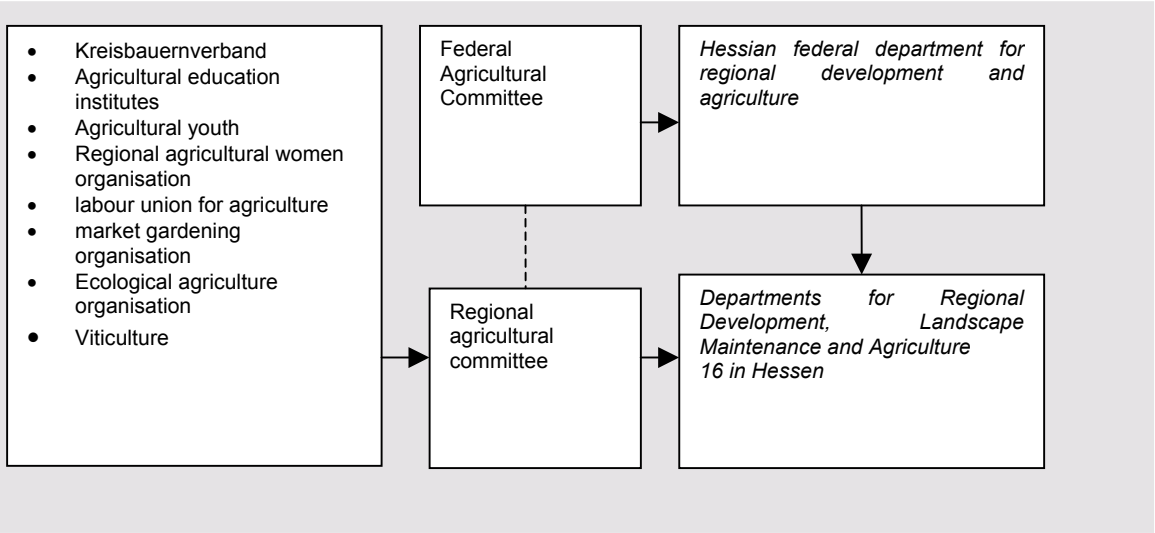



*Figure 14: Organisation structure of the agricultural interests*
*Source: Berufsstandsmitwirkungsgesetz*

[11] The regional government has to allow land-use changes in case of a conflict. Because the interests of the nature organisation mainly concern the changing of agricultural ground into nature protection areas, there is a matter of a conflict. When there is no conflict situation, the inter-municipal authority is authorised.

Other organisations that are concerned with the interests of agriculture are the water boards. The water boards have different backgrounds. In general three types of boards can be distinguished:

- Water boards that are related to the maintenance of a river. The members of these boards are the ground owners (mainly farmers and municipalities) of the rivers and the grounds around the river. In former times these organisations were primarily focussed taking measures to optimise the agriculture. The led in the sixties to the straightening and embanking of a lot of smaller rivers. Nowadays these organisations also have ecological objectives, for instance the renaturation of the dykes.
- Water boards that prepare farms (e.g. drainage).
- Water boards that are concerned with the providing for water for different purposes, as well drinking water as agricultural water. The water can be distracted from rivers and the ground water.

Although the primary task of these organisations does not concern agriculture, their interests are strongly related to those of the farmers, because farmers take place in these organisations.

***Interests and attitudes***

In general the interests of agriculture is to maintain the current situation or even increase the ground area that is used for agriculture. Because this interest is not realistic in the framework of the current political discussions, they have formulated three objectives:

- The farmers want to maintain the agricultural use in the areas between the summer and winter dikes because of the fertile grounds. Therefore the summer dike has to be maintained or even heightened in the framework of flood-prevention (In their opinion raising of the summer dike will increase the storage capacity during extreme high water, but will protect the agricultural areas longer in case of average high water). Because flooding mainly takes place in the winter, this will have no negative effect on the crops.
- The most optimal ground water level for full ground vegetables is between 2 and 3 meters below ground surface. This level should be maintained in agricultural areas.
- In case the agricultural structure has to change, the farmers prefer a smaller number of agricultural companies will a larger ground area.

The agricultural organisations are of the opinion that nature conservation areas have to be used first for the increasing of storage capacity. This means the constructing of a dike will control the flooding in order to optimise the storage capacity (by preventing a natural flooding of these areas). When this measure does not provide enough retention capacity the selling of grounds in the floodplains for storage capacity is negotiable. Conditions are then that development of storage capacity should be combined with nature compensation measures (ausgleich), in order to limit de decrease in agricultural ground surfaces. Furthermore no agricultural grounds behind the dikes should be used for retention. A remark that should be made is that the common interest of farmers contradicts with the individual interest. When a farmer receives a high price for their grounds, or there is a good arrangement for financial compensation, farmers are willing to give up grounds.

***Resources of influence***

The most important instrument of the farmers is the possession of grounds. In principle the government has the instruments to dispossess these grounds. In practice they are not willing to use this instrument because of the possible effects on the coming elections. Only in cases of high scale importance, like the construction of railways or safety maters, the government is willing to use this instrument. Compared to the Netherlands the ownership of ground surface is however of less importance. In the case study area there are wastelands, which make the exchange of grounds easier. In order to get a better price, farmers will resist to governmental initiatives to exchange grounds.

The FAC, RAC and the water boards are, as a representative of public interests, involved in planning processes. The effect of participation depends on the objective of the project. In general arguments that relate to economical or safety interests have a higher weight than agricultural interests. In the weighing of nature interests the farmers on the Hessian side are in the advantage that the state ministry of nature is also concerned with agriculture and the state government is more conservative.

***Relations***

The relations between the organisations involved with agriculture and organisations with other interests are little. Within the regional and federal governmental organisation relations take place in formal procedures and platforms. Comparable to nature conservation, this form of participation concerns mainly reacting on. Within the sector itself there are contacts with the different governmental levels. There are little contacts with other interests. Exemptions are personal contacts on a local level with local administrators.

## 5.5 Local economy

***Organisation***

The Industrie und Handelskammer (IHK) is the organisation that usually represents the interests of industrial and trade companies. All companies have to be registered at the IHK. This makes the IHK comparable with the Dutch Kamer van Koophandel. The IHK is organised on different levels: federal, state and regional. The main tasks of the IHK on a regional level are informing companies about new developments and participation in policy making processes. These are also spatial planing procedures. However, active participation in spatial procedures seldom occurs in local situations because this concerns only a small group of the companies they represent. More active involvement takes place on a regional and state level.

On the municipal level companies are often organised. When these organisations are recognised as a *Träger Offentliche Belange* they are invited to participate in planing processes. When this is not the case, industrial companies always have the right to give their opinion as a private person. In this last situation participation takes place in a later stage than in the first situation.

***Interests and attitudes***

The main interests of the industry are good economical conditions. This means a good infrastructure, low ground prices and safety. Companies that are located within the floodplains are responsible for their own flood control. In other cases companies do not have to co-finance flood protection. The only area that has concrete threads of high water is the economical area in Mainz (Rheinland-Pfalz), that is protected by an insufficient dyke. Within the area near the Rhine there are no clear needs for expansion.

Industrial companies have a positive attitude towards the construction of retention areas. However, when an area is constructed in the neighbourhood of their location, they area afraid of damage as a result of the increased ground water level. In the planning procedure of the retention area Trebur (Hessen) the objections of the European distribution centre of Mitsubishi played an important role. Some actors say that this company announced to move if a retention area would be constructed, what led to the decision not to construct it. In Rheinland-Pfalz a similar problem occurred near a housing area.

The local government tried to decrease or solve these fears by letting an engineering bureau developed technical solutions (extraction of drinking water (that decreases the groundwater level again) or the placement of a separation wall) that could decrease the ground water level back to the original level.

***Resources of influence***

The IHK represents a group of actors with a large amount of money. This group is quite powerful because of the economic importance for the region. Within the process of the expansion of Frankfurt this importance led to the decrease of an ecological area and also in the case studies this importance becomes clear. Therefore, economical interest can be interpreted as an interest with a high legitimacy.

The IHK is the only actor that interprets contacts with other organisations as a resource of influence. In the interview mainly the contacts with different mayors were mentioned as important.

***Relations***

The IHK has good relations with the different local and regional governments. They are often involved in an early stage of processes and are good informed about political developments. In order to reach their objectives they have to maintain the good relations, because they are dependent on the political climate. However, the governmental organisations are also dependent on the economical companies. As a result of the improved technology companies became more footloose and are less dependent on physical characteristics. In order to keep an economic strong region, the political climate has to be favourable for companies.

## 5.6 Synthesis

In this chapter a description is given of the different interests that are involved in the area that influences the discharge capacity of the river. Besides direct interests related to this area, also interest in other areas and non-spatial interests were described. These interests will influence the attitude and the actions of actors in all developments concerning this area. Based on this chapter, the following table can be constructed (figure 15 )

| Organisation | Interests in relation to the measures | Influence |
|---|---|---|
| WSV | • Keeping the river navigable and therefore a water level that is between +2.10nap and +6.50 nap.<br>• Prevention of sedimentation.<br>• Prevention of side-streams that can affect the stability of the river. | • Decision-making rights in all procedures that interfere with the cross-section of the river.<br>• Decision-making rights in all procedures that concern distracting water out or draining water into the river.<br>• Participation-rights in all procedures that influence the capacity of the floodplains.<br>• Status of federal government.<br>• Representation of economical interest. |
| Nature protection organisations | • Protection of marginal vegetation in floodplains.<br>• Vegetated riverbanks.<br>• No sudden flooding of floodplains.<br>• Possible expansion of natural areas in floodplains. | • Participation in all spatial procedures.<br>• Media support for ecological interests.<br>• The obligation of governments to compensate decrease in natural surface. |
| Economical interests | • Protection of current economical companies in or near floodplains and possibilities to expand.<br>• Maintenance of navigability of the Rhine<br>• Reasonable ground prices and therefore not large demands for nature protection. | • Bad economical climate and therefore public acceptance of interest.<br>• Social contacts with public representatives in the governmental organisations.<br>• Participation in decision-making procedures concerning all spatial developments. |
| Agriculture | • Maintenance of agricultural surface in floodplains and behind winter dikes.<br>• Maintenance of summer dike.<br>• No increase in the groundwater level. | • Organisation in official interest group and contacts with local government.<br>• Possession of grounds. |

*Figure 15: overview of the involved actors, their interests and their means*

# 6. The administrative system

## 6.1 Introduction

The objective of this chapter is to gain insights in how the German institutional system regarding river management of the Rhine in the case study area is constructed, which actors are involved, what their characteristics are and how they are related to one and another.

Therefore, in this chapter the administrative system concerning spatial and water policy will be discussed. The second section a description will be given of the administrative structure in Germany. In the third section the spatial planing system (general planning) will be discussed and in the fourth section policy fields that influence the spatial development, with a special focus on water management, will be described. Finally an overview on the different governmental organisations involved in decision-making will be given.

## 6.2 The administrative system and structure

***The administrative system***

The case study area, which belongs to one of the most densely populated areas in Germany, is situated on the border of two states (*Länder*) (the border is located in the middle of the Rhine). Together with 14 other states they form the Federal Republic of Germany. These states have a high degree of autonomy. They have their own government and establish their own laws. Furthermore, the national government has limited power to intervene in the authority of the states. An exemption to this are the first order water ways (of which the Rhine is one), these fall under the authority of the national government. Within the state lower administrative levels are established: the regional government, the district government and the local government. Each of these organisations has there own instruments to influence spatial development and the water management.

The western side of the Rhine falls under the authority of Rheinland-Pfalz. This state is today governed by a more progressive government, which consists of a coalition between the Social Democratic Party (*SPD*) and the Free Democratic Party (FDP). The eastern side is part of the territory of the state of Hessen, which is governed by the Christian Democratic Union (*CDU*). The CDU can be characterised as a more conservative party.

Concerning the development of the case study area, two groups of policy-makers are involved: General planning (*Gesamtplanung)* and policy fields that influence the spatial development (*Raumbedeutsame Fachplanungen*).

- General planing is the generic term for all forms of spatial policy, and contains planning on state level (including the *Regionalplanung*) and the municipal planning (*Bauleitplanung)*. General planning also includes the national laws concerning spatial planning (*Grundsätze der Raumordnung*), which are formulated by the federal government.

Within the general planning a distinction should be drawn between the superior planning (*Übergeordnete Planung)* and local planning (Örtliche Planung). Superior planning contains all forms of spatial planing that falls under the authority of the federal government and the states. The local planning is the planing on the level of the municipality. This differentiation is reflected for Hessen in figure 16. The difference is based on the laws that authorise these governmental organisations to develop these instruments.

- Policy fields that influence the spatial development are those governmental organisations that formulate objectives and prepare relating measures. The influence is based on national laws, which provide governmental organisations the authority to make plans that influence the spatial development. Examples of forms of policy fields that influence the spatial development are water management, traffic and communication, agriculture, environmental and nature protection and defence (Böhm, 1999).

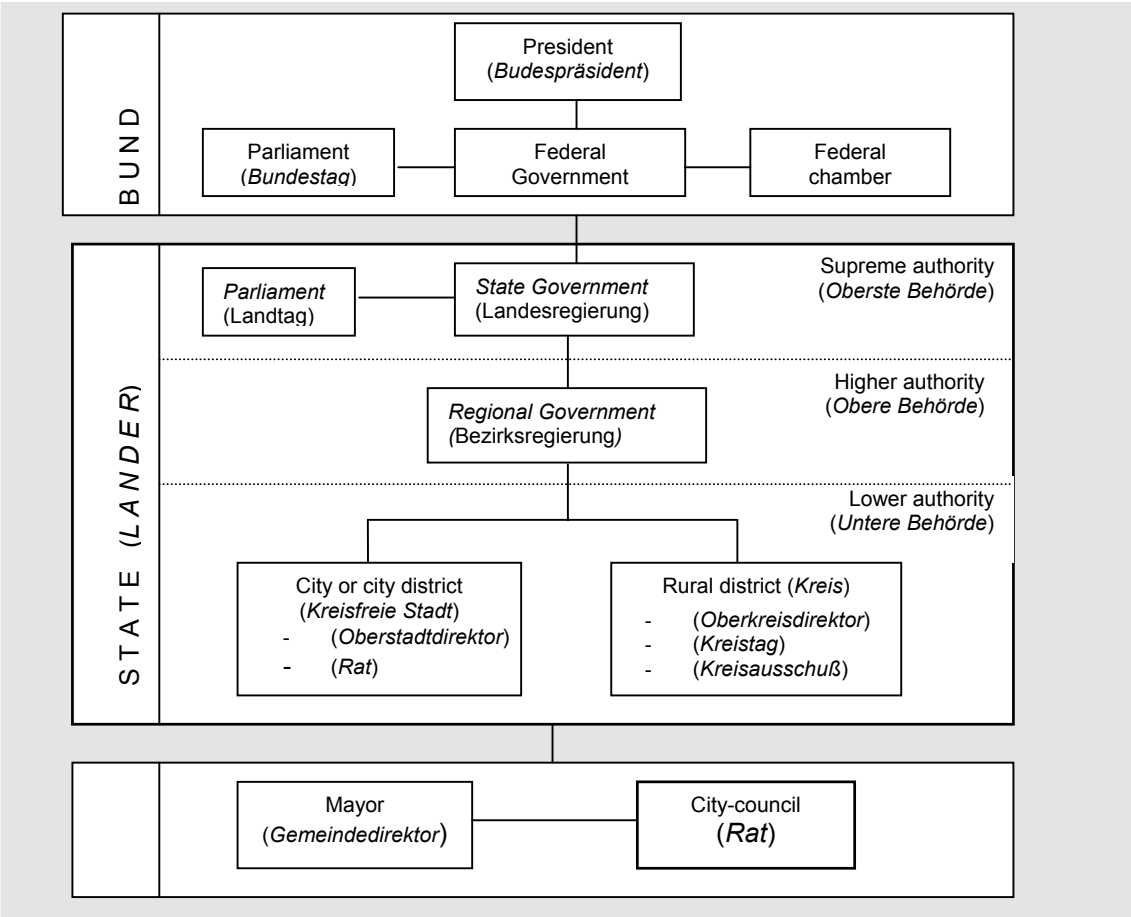



*Figure 16: German institutional system*
*Source: Kraayzank & Otter, 1993*

***The administrative structure***

In Germany there are three general levels of competence in addition to the European Union: the Federal Republic (the Bund), the states (Länder) and the municipalities (Gemeinde). These do not form a strict hierarchy but are each endowed with specific responsibilities. Many states have established regional governments (*Bezirksregierungen* or *Regierungspräsidien)*, thus adding a fourth level, although one that is subordinated to its state government (Kraemer & Jager, 1998).

However, the constitution does not grand power to this layer and therefore, the regional governments are not competent to develop policy on their own. Their actions have to be approved by the state government.

The division of the levels is based on the legislative competence. According to the constitution three forms of legislation can be distinguished.

1. Exclusively federal legislation, which is used for national issues for instance defence and foreign policy. States only have a legislative competence when they are authorised by the federal government.
2. Competitive federal legislation in which the states enforce legislation, but the federal government is also competent to enforce legislation.
3. Framework legislation, in which the federal government develops and enforces legislation, and the states have the obligation to complete this legislation by developing their own laws (Kraayenzank & Otter, 1993).

The states are divided in four layers. The upper layer consists of the supreme authority (*Oberste Behörde*[12]) which is ruled by the state government (*Landesregierung* or *Landesministerium)*. The higher authorities (*Obere Behörde)* are the regional governments (*Regierungspräsidien or Bezirksregierungen*) and the lower authorities (*Untere Behörde*) are the rural districts (*Kreise)* and the city-districts (*kreisfreie Stadte)*. A rural district is a group of municipalities that execute inter-municipal responsibilities together. City districts are municipalities that are authorised to enforce all municipal tasks themselves. City districts are larger municipalities whereas rural districts exist of a group of smaller municipalities. (Kraayenzank & Otter, 1993) The lowest administrative level is the municipality that consists out of one or more villages. All administrative levels are subdivided in departments, concerned with different issues.

## 6.3 General planning

### *Objectives*

The objectives of governmental organisations with competencies concerning general planning are described in governmental plans. The regional and state plans are mainly conservative and aim at a good economical settlement climate, however, this is more focussed on the areas near the economical centres. For the municipalities near the Rhine there are some local expanding plans for housing and industries, but no large spatial changes are planned.

The local governments however have a clearer objective: to expand. Local governments are partly dependent on local taxes. This means expansion is interesting. Furthermore, local governments are also the representatives of local interests in procedures because inhabitants often do not have an own organisation.

### *Superior planning*

[12] Behörde(n) is the generic term for governmental organisations in Germany.

The constitution gives the national government the competence to develop and establish framework legislation concerning the spatial organisation in Germany. Therefore the federal government has developed the Law for Spatial Planning (*Raumordnungsgesetz*) (ROG). In this framework law the federal government formulates the assignments, concepts and also the fundamental ideas for spatial planing. (Böhm, 1999)

Besides the formulation and establishment of the ROG, the federal government is also responsible for the translation of European policy to the national level and transboundary co-operation with neighbour-countries.

The governmental organisation that is responsible for spatial planing on a national level is the *Bundesministerium für Raumordnung, Bauwesen und Stadtbau*. Another key-actor on national level is the *Ministerkonferenz für Raumordnung* (MKRO). The MKRO is an association in which the state ministers concerned with spatial planning are represented. The MKRO co-operates with the national government in the developing of spatial policy. Examples are the *Raumordnungspolitischer Orientierungsrahmen*, in which the perspectives, concepts and strategies for the spatial development are represented. The MKRO itself has no legal instruments and therefore can not enforce other actors to adopt these recommendations (MKRO, 2000). Besides in the MKRO, the states are also represented on federal level in the federal chamber (*Bundesrat*), that can influence the enforcement of legislation (Kraayenzank & Otter, 1993).

The State Law for Spatial Development (*Landesplanungsgesetz*: LPG) complements the ROG creates the legal basis for the state and regional planning. According to the ROG, the states are obligated to compose plans or programs for the area that falls under their authority. State planning, including the regional planning, has the task to co-ordinate municipal planing forms (Böhm, 1999).

The most important instrument for spatial planning on state level is the plan for spatial development (*Landesentwicklungsprogramme* or *–pläne)*. This plan contains the preconditions for the spatial organisation and the development of the state, and should be considered in all measures and plans that influence the general planning. According to the ROG, the Landesentwicklungsplan should at least contain statements about:

- the present and future urban structure and function of the different parts of these structures in relation to their environment;
- the present and future rural structure and the forms of use that parts of these structures have. Examples of uses are nature- and landscape conservation, groundwater protection, forestry, agriculture and recreation;
- the areas that are reserved for infrastructural constructions. (Böhm, 1999)

The minister concerned with state planning is responsible for the contents of the State Spatial Development Plan. The procedures for the developing and enforcing a *Landesentwicklungsplan* have been settled in the LPG and therefore are different for all the federal states. The *Landesentwicklungsplan* or *-programme* is binding for all public authorities.

As a part of the state planning, the regional-planning translates the plans and programs of the states into a more detailed plan. The most important planning instrument for regional-planning is the regional plan (*Regionalplan or Raumordnungsplan)*. The regional plan contains the objectives for the development of the region according to the preconditions that are formulated by the state. In the process of composing the plan, the regional governments are obliged to involve the concerning municipalities, because the regional plan intervenes direct in the authorities of these governmental organisations. Furthermore, they are obliged to involve the *Träger Offentliche Belangen* (TOB´s) and the in § 29 of the nature conservation law, recognised organisations. (Böhm, 1999; §7 landesplanungsgezetz). The regional plan has to be approved by the state ministry involved with spatial planning.

The regional plan has to describe the current spatial structure. Furthermore, it has to contain statements about the following issues (HLPG, § 16.6).

- Areas for the expansion of settlement and industrial areas;
- Areas reserved for the extraction of water or raw materials (minerals, sand, and etceteras).
- Areas reserved for the expansion of infrastructure.
- Areas that are of importance for the maintenance of nature and landscape conservation.
- Areas suitable for the development of forest.
- Areas in which agricultural land-use has priority.
- Areas that are reserved for climate-protection, soil protection and high water protection.

Within the regional plan the government has the possibility to appoint priority zones (*Vorranggebiete*) and reservation-zones (*Vorbehaltsgebiete*). Priority zones are areas that have been allotted for certain, spatial relevant, forms of land-use that can not be combined with other forms of land-use. Reservation zones are areas where a certain form of land-use is of special importance but does not exclude other forms of land-use. The destination reservation-zone implies that in future this form of land-use has to be respected in spatial developments (MKRO, 2000).

***Local Planning***

Local planning is (*Bauleitplanung)* is the generic term for spatial planing on the level of the municipality. The local planning is, in contradiction with other planing levels, based on Federal Law for Building (*Baugesetzbuch*) (Böhm, 1999). The two most important instruments for local planning are the Flachennutzungsplan and the Bebauungsplan. In the formulation of spatial objectives and the design of plans, objectives of other plans have to be taken into consideration. In respective of water management, the municipality has to adopt the floodplain, as defined at a higher level. Furthermore, the municipality is obliged to provide a safe living and working area for its inhabitants (BGB: 1.5). This means, that when there is information that indicates the need for high water measures, the municipality has to reflect these measures in their planing (Dapp & Heiland, 1999).

The *Flachennutzungsplan* is preparatory to the *Bebauungsplan*. This plan reflects the spatial objectives and related spatial structure for the entire municipality, including the floodplains. The *Flachennutzungsplan* is not direct binding for individuals, only for governmental organisations.

Nevertheless, it influences the inhabitants of the municipality indirect because it is the *Bebauungsplan*.

In the planing procedure of defining the *Flachennutzungsplan* the municipality is obligated to consider other interests. This takes place in two different ways: they have to consider objectives of other policy fields according to the *Gegenstromprinzipe* (figure 17) and they have to give the TOB's the possibility to react on the concept-*flachennutzungsplan*. Some of the municipalities involve TOB's also in an earlier phase, this however is not obligatory. When the plan has been designed and participation has taken place, the plan has to be approved by the district and regional government.

**Gegenstromprinzipe**

General planning on all levels is characterised by the Gegenstromprinzipe that enables authorities to influence each other's plans. On the one hand planning of higher governments is binding for lower governments. This means municipal plans have to adopt the policy of the regional governments (appointing floodplains, nature conservation areas, etceteras), and the regional governments has to adopt the policy that has been developed at state level. Nevertheless, higher authorities are obligated to involve authorities of the level beneath them in the development of policy.

*Figure 17: the Gegenstromprinzipe*
*Source: Euregio Rijn-Waal, 1995*

The *Bebauungsplan* is based on the *Flachennutzungsplan*, this means that is that is can not conflict with the *Flachennutzungsplan*. The *Bebauungsplan* settles in detail the place, nature and size of the buildings on parcel level. *Bebauungsplane* are most often designed for new to develop parts of the municipality.

Municipalities are to a large extent dependent on local taxes. Therefore they are benefited from a good economical position. This derives from employment within the municipality, the number of inhabitants and the number of tourists. However, based on the official governmental tasks, their priority is to guarantee the safety of inhabitants.

### 6.4 Policy fields that influence spatial development in the case study area

Policy fields that influence the spatial development are those policy fields that develop objectives and prepare measurers, which influence the development of the land-use (Böhm, 1999). However, almost all policy fields influence the spatial development (in)directly to a certain extent. For certain policy fields this influence is arranged in the law, because the objectives of these policy fields have to be taken into account in the development of general planning. Examples are the forest protection plan (this appoints all nature protection zones) and the landscape protection plan. Other policy-fields are part of the general planning, for instance the ground surface that is reserved for the expansion of industrial areas and housing areas, which relate to the objectives concerning economical development. These surfaces have to be set in the regional plan and the *Bauleitplanung*.

It is of little value to discuss al policy fields that influence the general planning. Therefore this section will only describe the policy fields: water management en nature conservation. The first

because it plays an important role in the taking of the measures. The second because of the compensation principle.

***Water management***

*Federal government*

The federal government has is compelled, according to § 75 of the constitution, to develop framework legislation) for water management in Germany. This framework legislation, called the *Wasserhoushaltgesetz* (WHG), defines the responsibilities and instruments for the states to develop sufficient water management. This implicates that water management is mainly the task of the state governments. An exemption to this is the responsibility for quantitative management of federal waterways, used for navigation, which is not delegated to lower authorities (Kraayenzank & Otter, 1993). This is the responsibility for the Federal Ministry for Transport, Construction and Housing, which has delegated this task to the *Wasser und Schiffahrts Verwaltung des Bundes* WSVB. The WSVB concentrates on navigation and not on safety matters. The WSVB is sub-divided in several departments. The section of the Rhine in the case study area falls under the responsibility of the *Wasser und Schiffahrtsamt* Mannheim (WSAM), which is responsible for the Rhine section between Karlsruhe and Mainz. As already discussed in the previous chapter, the WVSM has the objective to keep the river navigable. In this matter they have decision-making rights concerning the recharge and discharge of large amounts of water out of the Rhine.

**Spatial-planning-procedure (*Raumordnungsverfahren*)**

The spatial-planning-procedure is required in projects that take place on a higher level and gives insights in:

- the effects of a project on other forms of land-use in the region,
- the correspondence of a project with the spatial policy,
- the environmental effects of the project (Böhm).

The governmental organisation that carries out the procedure depends on the project. For projects that have an effect on the entire state and take place on land the state-government is responsible. For projects on a lower scale level the regional government is responsible. For projects concerning federal waterways the WSVB is responsible. The different interest organisations and governmental organisations have the possibility to participate in the procedure through a written reaction on the project. After the regional government has taken the different remarks into consideration, they decide if the project can be continued. After a decision is taken, a plan-approval-procedure still has to be carried out.

**Plan-approval-procedure (*Planfeststellungsverfahren*)**

The plan-approval-procedure is to a large extent similar to the spatial-planning-procedure, but focuses on a smaller scale level and on a larger detail level. When a plan contains several alternatives, a selection will also take place in this procedure. Everyone that is affected by the project can react. This in contradiction with the spatial-planning-procedure where only the official recognised nature organisation and other representatives of a public interests can react. When the plan is approved, a license has to be given in the *genehmigungsverfahren*. This is also the last possibility for people to object to the plan.

*Figure 18: procedures*

For measures that concern the construction or changing of federal waterways the WSV is responsible for carrying out a trace-procedure (*lauflinienbestimmungsverfahren*) (Euregio, 1998) followed by a planning-approval-procedure (*planfeststellungsverfahren*). The WSV is also competent to make a decision in these procedures. The trace-procedure is similar to the spatial-planning-procedure (*raumordnungsverfahren*). The planning-approval-procedure and the spatial-planning-procedure will be discussed in figure 18.

*Supreme authority*

The supreme water authority are the ministries concerned with water management (Hessen: Ministerium für Umwelt, Landwirtschaft und Forsten; Rheinland-Pfalz: Ministerium für Umwelt und Forsten) and have the task to make strategic decisions in water management and supervises lower water authorities and agencies. In this matter, the state has two instruments: the state water law and the *Wasserwirtschaftliche Rahmenplan*. The State Water Law complements the WHG. The State Water Law defines what the competencies of the different water authorities are, what the objectives concerning water management are and the instruments that are available to reach these objectives. Furthermore is the supreme authority, according to § 36.3 WHG, obligated to develop a *Wasserwirtschaftliche Rahmenplan*. In practice the regional governments (Kraayenzank & Otter, 1993) often develop these plans. In the case study area there is a *Wasserwirtschaftliche Rahmenplan* Rheinhessen. In the region of south Hessen there is no actual *Wasserwirtschaftlich Rahmenplan* (Böhm, 1999).

Within the *Wasserwirtschaftlich Rahmenplan* objectives for ground and surface water quantity and quality are described. Concerning the water quantity of the Rhine, the objectives correspond with those made in the agreement between the three states and France. The State Rheinland-Pfalz is further in realising the objectives concerning safety than Hessen. According to some sources is related to the commitment and the social skills of the minister in Rheinland-Pfalz concerned with the issue high water protection.

Concerning high water protection, most competencies are delegated to the higher authority. The supreme authority has to give approval in the procedures, but this concerns more if the procedure is carried out right than the contents of the plan. Furthermore, the supreme authority is competent to appoint the location of retention areas.

*Higher authority*

In Hessen the higher authority concerning water management is the *Staatliches Umweltamt* of the regional government. In Rheinland-Pfalz this is the *Struktur- und Genehmigungsdirection Süd*. Both will be referred to as the regional government, department water. The objectives of these organisations are improving the safety of the region. Therefore the dykes have to protect the region for a high water level of 1/200. Therefore the existing volume of the floodplains should not decrease, which means no settlements are allowed in the floodplains[13]. A second objective that is formulated on both sides that the awareness of flooding risks should increase in order to prevent a growth in the damage potential of flooding.

As described in the above section, the regional water government is often involved in the development of the *Wasserwirtschaflich Rahmenplan*. Another plan in which the regional water government is involved is the *Bewirtschaftungsplan*. The *Bewirtschaftungsplan* aims at regulating and protecting the water that is relevant for nature protection and the protection of the available groundwater, while taking the drainage of local and regional rivers and demand of the different forms of land-use into account. In Rheinland-Pfalz, these statements have been represented in the *Wasserwirtschafliche Rahmenplan*. Concerning the Region Sud-Hessen, a Groundwater-*bewirtschaftungsplan* has been developed for the region the Ried. In this plan the maximum and minimum groundwater levels for a number of regions have been set. Not only the

[13] An exemption is temporarily or seasonal settlement in times of low water, like camping sites.

regional government, but also district governments and Water Boards (*Wasser und Bodenverbande*) were involved in the development of this plan.

Concerning the issue high water protection, the regional government is responsible for the planning and maintenance of the winter dykes. In order to reconstruct or heighten the dykes, the regional government has to start a planning-approval-procedure. The regional government is competent to make a decision in this procedure when this concerns raising of the dikes. When the regional government also wants to replace the dike, a spatial-planning-procedure has to be carried out previous to the planning-approval-procedure. Because the water-department is only competent to make decisions about interference in the floodplains, the spatial department of the regional government will be also involved in this procedure. The decision-making right of the spatial-planning-procedure lies at spatial department of the regional government. Before the approval is given, first the state government and the *regionalversamlung*: an organisation that consists of the regional government and the municipalities, have to give an advice.

Furthermore, the regional water government has the authority to licence water-use. In cases of smaller water uses that do not affect others, the district government mainly does the licensing. Concerning larger uses, where a planning-approval-procedure is needed, the licensing is the responsibility of the regional government. The policy of the Regional water government has to be respected in the regional plan. An example is the ground water protection zones that are appointed in the regional plan. In this matter three zones can be distinguished. Besides licensing drainage the regional water government is also responsible for licensing exemptions to the prohibition to build within the floodplains.

*Lower authority*
The Lower Authority (District) does not develop plans concerning water management. However, they can licence smaller individual water uses that do not affect other parties. Within Hessen the lower authority is also involved in licensing exemptions to the prohibition to build within the floodplains. The reason for this is that they are often better informed about the local situation.

*Municipality*
The municipality is responsible for the maintenance of the summer dikes. An exemption to this are dikes within nature conservation areas, which fall under the responsibility of the Federal State Government (which delegated this to the regional government). Concerning the winter dike the municipality is only responsible for small reparations. Other issues that fall under the responsibility of the municipality are amongst others licensing small forms of drainage and drinking water supply. In a large number of German municipalities this last responsibility is contracted out to private companies.

Concerning measures in water management, the local governments are also able to influence decision-making through participation and their place in the *regionalversamlung*. Although this is a democratic system, smaller municipalities note that their interest is often minor to the economic development.

***Nature conservation***

Nature and landscape conservation is mainly arranged in landscape planning. Because the contents of nature conservation policy is already integrated in the general planning, the planning system of landscape conservation will not be discussed.

Beside the plans on the different governmental levels also other instruments have been introduced that have to prevent unwanted developments and to rehabilitate nature and landscape in case of realisation of major plans. The most important instrument is the nature-compensation-rule. It is meant to prevent avoidable operations and to compensate unavoidable operations that damage nature and landscape processes. The person/company that causes interference in nature or landscape is obliged to reduce and/or compensate damage done to nature or landscape. In this matter a value-system has been introduced that values the damaged nature and translates this into a number of points. The one the cause the damage to nature has to compensate by recreating the number of points. However, nature conservation organisations object to this system, because often seldom biotopes are damaged and compensated by more general biotopes.

## 6.5 Synthesis

Although the state governments is official the most powerful player, most responsibilities are delegated to the regional government. The spatial department and the water department of the regional government are involved in all measures that involve the floodplains. The role of the state government is limited to approval, but this mainly concerns the followed procedures instead of the contents. Concerning measures that influence the cross-section of the Rhine, the WSV is competent to make decisions. Local governments have the right of participation in the procedures, but have no final say in the outcomes. In the interview the local government noted that they often feel unheard, especially when it involves economical interests.

In order to intervene in the present situation, policy has to be established in the spatial plans. For long-term policy, the regional government is competent to reserve already space in the regional plan. This plan has to be approved by the state government. The regional plans are the framework for the local plans. When policy has to be implemented, the government has to carry out two procedures: the spatial-planning-procedure and the plan-approval procedure. The responsible government makes decisions in these procedures. Concerning the cross-section of the Rhine this is the WSV, concerning measures that influence the floodplains this is the regional government, department water, concerning measures behind the winter dikes this is the spatial planning department of the regional government. In all procedures representatives of a public interest, recognised nature conservation organisations and other involved governmental organisations can participate.

For a number of spatial developments (a description of these measures is given in annex 2) that influence the discharge capacity of the Rhine, the competencies of the different governmental organisations are represented in figure 19.

| Measure | Decision-makers | Procedure | Approval |
|---|---|---|---|
| Raising of the winter dikes. | Regional government, (dep. water) | Spatial-Planning-Proc. | State government |
| Raising of the summer dykes | Local government or Regional government in nature conservation areas | Planning-Apporval-Proc. | Regional government |
| Expansion of floodplains | Regional government (dep. water and spatial dep.) | Spatial-Planning-Proc. and Planning-Approval-Proc. | State government |
| Construction of retention areas. | Regional government (dep. water and spatial dep.) | Spatial-Planning-Proc. and Planning-Approval-Proc. | State government |
| Construction of a periodical or permanent side channel | WSV and Regional Government (dep. Water) | Spatial-Planning-Proc. or Planning-Approval-Proc. (depending on scale) | Regional Government |
| Lining of the bottom | WSV | trace-procedure | Federal Ministry for Transport, Construction and Housing |
| Pavement of the river banks | WSV and Regional Government (dep. water) | Planning-Approval-Proc. | State governments |
| Dredging of the river | WSV | trace-proc. | Federal Ministry for Transport, Construction and Housing |
| Lowering the floodplain | Regional Government (dep. water) | Spatial-Planning-Proc. and Planning-Approval-Proc. (depending on scale) | State governments |
| Spatial developments in the floodplain | Regional government (dep. water) | Planning-Approval-Proc. | None |

*Figure 19: overview of decision-makers*

# 7. Decision-making processes and spatial developments

## 7.1 Introduction

This chapter will give a description of two processes in the case study area that took place in the framework of water management and influenced the spatial development. The objective is to give insights in the elements that are the driving forces behind the processes in the institutional system and therefore behind the influence of the social organisation on the spatial organisation (research question 3).

Therefore, the chapter is constructed of five sections. The first section describes the background of the decision-making processes. The second section describes a case on the side of Rheinland-Pfalz. The third section describes a case in the state Hessen. The fourth section compares both case and points out the important factors that influence the outcome in regional decision-making processes in Germany. The fifth section contains a synthesis.

## 7.2 Background of the decision-making processes

The dikes that protect the case study area against flooding have been designed to be 20 cm above the water level during the flood of 1882/1883, which had discharges of 5440 $m^3$/sec at Worms and 6940 $m^3$/sec at Mainz. Since these adjustments, no major changes occurred in the hydrograph of the Rhine (Ministerium fur Umwelt und Forsten Rheinland-Pfalz, 1998) and therefore there was no need for large adjustments in the high water protection system in this area. This changed as a result of the construction of six hydroelectric power plants between Breisach and Iffezheim, which took place between 1955 and 1977. Because the lower and middle water levels were considerably raised, as a result of these constructions, the floodplains on both sides of the Rhine had to be protected against flooding. This intervention led to a decrease of 130 $km^2$ of ground surface of the floodplains and the discharges (figure 20)

| **Season** | **Risk of occurrence** | **Symbol** | **Worms** Discharges in $m^3$/sec | | **Mainz** | |
|---|---|---|---|---|---|---|
| | | | 1955 | 1977 | 1955 | 1977 |
| Winter | 1/100 | WiHQ100 | 5600 | 6300 | 7300 | 7900 |
| | 1/200 | WiHQ200 | 5900 | 6700 | 7900[14] | 8700[1] |
| Summer | 1/100 | SuHQ100 | 4600 | 5100 | 4900 | 5200 |
| | 1/200 | SuHQ200 | 4900 | 5500 | 5100 | 5500 |
| Year | 1/100 | HQ100 | 5700 | 6400 | 7300 | 7900 |
| | 1/200 | HQ200 | 6000 | 6800 | 7900[1] | 8700[1] |

*Figure 20: discharges before and after construction of hydrological power stations*

*Source: Ministerium fur Umwelt und Forsten Rheinland-Pfalz, 1998*

[14] As a result from the high water in 1882/1883, a collapsing of the dikes near Worms created an area, which was connected to the Rhine with a discharge capacity of 1000 $m^3$/sec. The values in table 6 are based on the discharges without considering the capacity of this area.

Figure 20 shows a large difference between the discharges (that occur once in 100 years and once in 200 years) after the construction of the hydroelectric power plants. The increased discharges are a danger for the land behind the dykes. Concerning the case study area, the flooding chances are even more intensified as a result of the high water peaks of the Rhine and the Neckar during the winter, now occur simultaneously (Drucker, 1998). These changes are the result of river training measures that have taken place within the Neckar.

In the current situation, the dykes on the west banks of the Rhine are (based on a freeboard of 20 cm) designed to guarantee a protection against a maximum discharge of 6000 m3/sec (HQ200) between Worms and Mainz. Downstream of Mainz the dykes guarantee a protection against a maximum discharge of 7300 m3/sec (HQ200) (Ministerium fur Umwelt und Forsten Rheinland-Pfalz, 1998). The value on which the flood protection is based is referred to as the normative discharge. In some areas the dykes are lower. The areas behind these dykes will flood before the normative discharge will be reached. In figure 19, the changes in flooding of the dykes in the current situation are represented for the years 1955 and 1977. The values of the risks of occurrence in figure 21 are based on the values given in figure 20. In figure 21, there is also a column (1977T) that represents the risk of occurrence when retention areas, that have been constructed in the French part of the Rhine are taken into consideration. These areas have a total retention volume of 100 million $m^3$ (Ministerium für Umwelt und Forsten Rheinland-Pfalz, 1998). These retention areas were used for the first time during the high water peaks of 1988. The use of these retention areas led to a decrease in the water level of 23 cm at Maxau and 5 cm at Köln, enough to prevent the historical centre of this town from flooding (Middelkoop, 1998;)

| **Section** | **Normative discharge** | **Risk of occurrence** | | |
|---|---|---|---|---|
| | | 1955 | 1977 | 1977T |
| From the river mouth of the Neckar (Worms) until the river mouth of the Main. | 6,000 $M^3$/sec | 1/200 | 1/55 | 1/90 |
| Downstream of the river mouth of the Main. | 7,300 $M^3$/sec | 1/100[15] | 1/55 | 1/75 |

*Figure 21: occurrence risk of normative discharges in current situation*

*Source: Ministerium fur Umwelt und Forsten Rheinland-Pfalz, 1998*

Figure 21 reflects the protection of the dykes that are situated in Rheinland-Pfalz. Because the design, construction and maintenance of dykes are the responsibility of the state government, the dykes on the side of Hessen are not the same. Compared to the dykes in Rheinland-Pfalz, the Hessian dykes are higher, but also weaker. Due to the construction, some of the dykes are not able to cope with a risk of occurrence higher than 1/25 (Mr Gieseler, Mr Löw).

In order to reduce the risk of flooding, the dykes along the Rhine need to be strengthened and raised. However, for a more sustainable reduction of these risks other measures are needed. In this matter, the *Internationale Hochwasserstudienkommission* advised the construction of a system of retention areas in the Upper Rhine. This advice has led to an agreement (1977)

[15] This number is based on a situation without the floodplain that is referred to in footnote 1. With the use of this area, the risk of occurrence will decrease from 1/100 to 1/200.

between the French Republic and the Federal Republic of Germany to construct a number of retention areas in the upper Rhine with a total volume of 226 million $m^3$, in order to restore the hydrological situation that was present before 1955. Initially the agreement intended to construct this volume upstream of Worms. In a later phase it was decided to construct 10 million m3 of this volume should be constructed downstream of Worms (Ministerium für Umwelt und Forsten Rheinland-Pfalz, 1998).

Besides Rheinland-Pfalz also Baden-Württemberg (126 million $m^3$) and France (53 million $m^3$) agreed to construct retention-volumes. Although Hessen did participate, they did not commit themselves to constructing retention-volume. The reason for not constructing retention-areas is the small part of Hessen that is located upstream of Worms (interview Regional Government Hessen).

The implementation of measures to create this retention volume did, however, not take place until the late nineties[16]. As a result of the high water peaks in 1993 and 1995, that caused floodings in Köln and Bonn, the political and public awareness of the risk of flooding increased. This placed the subject of high water protection again on the public agenda (WWW.IKSR.de). The raised-awareness of the problems related to a possible flooding also led to the Action Plan on Flood Defence of the International Committee for the Protection of the Rhine (ICPR). This plan advocates reserving more space along the river for the retention of water at times of peak discharges. The main objectives are to reduce the risk of flood damage by 25% in 2020 and to reduce the peak discharge water level downstream of the upper Rhine by 70cm in 2020 (RIZA, 2000).

In the framework of the agreement between France and the German states, river training measures were planned in the case study area. These measures concern both the strengthening of the dikes as the creation of retention volume. In Rheinland-Pfalz two retention areas will be constructed. The first is located near Mainz-Laubenheim, the second retention area is located near Worms-Rheindürckenheim. Both retention-areas will be controlled, of which the second with an ecological pre-flood. On the Hessian side no retention-areas will be constructed since the agreement contains only conditions about the construction of retention areas upstream of Worms. However, the Hessian government did attempt to construct such an area near Trebur.

## 7.3 Case 1: the construction of a retention area near Mainz-Laubenheim

### *Introduction*

Mainz-Laubenheim is located upstream of Mainz. Mainz-Laubenheim itself is governed by city-district government (*Ortsbeirat*), which represents the interests of the city-district on municipal level by advising the city council of Mainz. Although the district government is chosen, all municipal competence rights (also the decision-making rights for spatial development) fall under the responsibility of the city-council of Mainz. This council has delegated some task to the district level.

[16] Concerning the case study area, however, some of the retention areas upstream were already finished.

Mainz-Laubenheim is a small suburb of Mainz with approximately 10.000 inhabitants. The housing area is partly constructed in the former floodplains, which are protected by a winter-dike that is situated close to the Rhine. Because of the low housing prices in this part of Mainz-Laubenheim the inhabitants consist mainly of people with a low income and people that only live there for a short amount of time (students) (interview Mainz-Laubenheim). A group that is little organised and has little means to influence developments.

In the areas around the village are mainly used for agriculture alternated with some nature. The area has also a recreational function for inhabitants of Mainz.

In the framework of the international agreement the state government of Rheinland-Pfalz took the initiative to construct a fully controlled retention area in the floodplain with a total retention-volume between 6.2 and 7.2 million m3 (dependent on the variant that would be chosen in a later phase) The area would have a flooding frequency of 1/25 years and would be fully controlled. The land-use in this area would remain agriculture and some nature conservation (the existing nature conservation area will be maintained). Furthermore, there would be recreational co-use.

The retention was planned near the housing area in the former floodplain.

***Actors***

Corresponding with the administrative structure (chapter 6) the decision-making rights are located mainly at the regional governmental level. Local governments are involved through participation (reacting on plans) and the regional advice board (in which all municipalities are represented). The state government gives the approval for the plan and was involved in appointing the location for the retention area. The most important governmental organisation is therefore the *Struktur und Genehmigungsdirection Süd*: the regional water government because they co-ordinated the project.

Besides actors that are involved based on their governmental responsibilities also other actors are involved. In this area the most important actors are the local inhabitants, the local farmers and the nature-protection organisations.

***The institutional system***

The regional and state government were very committed to the realisation of retention-areas. Parallel to this specific project, the state government has started an information campaign to raise awareness of the risks of flooding and the need for taking measures. This campaign is focussed as well on municipalities as non-governmental organisations and local inhabitants. The driving force behind this campaign is minister concerned with high water protection in Rheinland-Pfalz, which is very committed to the issue (interview regional government Rheinland-Pfalz, interview NABU). The reason for the commitment is bipartite. First Rheinland-Pfalz has the obligation to construct these areas that derives from the agreements. Second, the commitment is raised by the location of an economical important centre (the city centre of Mainz) just downstream of Mainz-Laubenheim. Because the centre of this town is relatively low, a high water peak could lead to a direct flooding of the entire centre. In this matter, the measure can be interpreted as an extra insurance (interview Mainz-Laubenheim). This commitment,

combined with the personal skills of the minister ( to which different respondents refer) play an important role in the process.

The local governments that are involved are the city council of Mainz and the city-district government (*Ortsbeirat*). The city council represents the interests of all inhabitants. The interest of the inhabitants of the city centre is to construct the area. As explained, this would mean extra protection of housing and economical functions. However, they also have to represent the interests of the local inhabitants of Mainz-Laubenheim, which conflict to those of the entire of Mainz. The city council of Mainz plays an important role in the regional advice committee, which judges regional policy. Although all municipalities are represented in this committee, the representatives of Mainz and Worms are the actors with the most power in these processes (interview Mainz-Laubenheim).

The main concern of the inhabitants is that of ground water problems in their basements (that are constructed partly below ground level and are used for daily living). They have however little means to defend these interests, there the city-district government only has an advising function and decision-making competencies. (Interview Mainz-Laubenheim). The city-district government is not allowed to go to court, but local inhabitants are. These inhabitants however are little organised and because of their low income or temporary housing situation not likely to go to court.

The interests of agriculture conflict with the measures since they will lead to a decrease in ground surface (for the replacement of winter dikes) and agricultural grounds will flood once in 25 years. However, the objectives of the farmers mainly concern the way measures are taken, and not the problem or the need of taking measures. The farmers have the ownership of grounds. Since it is not likely that the government will use the instrument of dispossession, this group of actors is of influence and importance on the process, and therefore the regional government takes their interests into account.

***The decision-making process***

Previous to the initiation of constructing the retention-area near Mainz-Laubenheim the information-campaign started. Through this campaign the government raised awareness of the problem and the necessity of taking measures from a safety point of view. The effect of this campaign was intensified by the high water peaks in 1993 and 1995.

The starting point for the process was the pointing out of the location. Although the construction of retention volume in the area was not open for discussion, stakeholders could react on the plan. Based on the reactions, the government did reformulate the objective of the process. This led to a process where not only the construction of the retention-area was placed on the agenda, but also a healthy agriculture with a growing perspective and the maintenance of the nature conservation area (interview Regional government). Because of the information-campaign and the attitude of the regional government to take the interests into account, the process of negotiation was much more open and had a more integrative character. Concerning the concerns of the local inhabitants, the government hired an engineering agency that developed technical measures to prevent the occurrence of the negative effects. Despite these solutions, inhabitants were not reinsured and maintained their negative attitude towards the construction. According to the city-district-government, the local resistance can decrease if the

government will guarantee that ground water problems will not occur. However, the city council of Mainz is not willing to giver this guarantee.

Actors only participated through formal participation-moments in the spatial-planning-procedure and the planning-approval-procedure. Besides that, stakeholders participated indirect through the governmental department with a corresponding interest.

The main process of negotiation concerned the issues: whether or not to involve the nature protection area in the retention area and the way farmers were compensated. The decision in concerning the nature protection area was derived from the planning-approval-procedure, which compares the contents of the plan to the different local policy objectives. Within the local policy the government had pointed this area out as a nature protection area for non-floodplain nature. The decision concerning the compensation for the flooding of the retention-area was based on an economical damage analysis made by an independent institute. Furthermore, because the construction needed ground for the replacement of dikes, smaller farmers were bought out and reallocation of grounds took place (interview Mainz-Laubenheim, interview Regional government Rheinland-Pfalz).

The outcome of the process is that the retention area will be constructed in the smaller alternative and that farmers will be compensated for their financial damage (the compensation is based on an independent research).

Of all participants only the inhabitants feel unsatisfied with the result and they still fear groundwater problems. When the technical measures are taken, the government does not expect to experience groundwater problems, and therefore they will implement the measure. Especially because the local inhabitants are not likely to delay implementation because they are badly organised and have little resources of influence.

## 7.4 Case 2: The construction of a retention area near Trebur

### *Introduction*

On the Hessian side a retention area was planned between the Kuhkopf-Knoblochs Aue and the confluence of the Main. The retention-area, with a ground surface between 1312 ha and 1600 ha, and would be partly controlled and partly uncontrolled. This last part would be used for nature development (Mock a.o., 1991). In the current situation the entire area is used for agriculture and near housing. Furthermore, there are some larger industrial companies, which are located close to the winter dike. Similar to the situation in Mainz-Laubenheim, the location of the dike after replacement would be closer to the housing and industrial areas than in the current situation.

The starting point of the process was an initiative of the WWF-floodplain-institute and the Hessian Ministry of Environment. They developed a plan that was worked out in a high detail level and presented this to the local governments. Although there were possibilities to react on this plan, the local governments felt left out because they were not involved in an earlier phase. This did not only concern the municipality in which the retention area was planned, but also the surrounding municipalities (interview municipality Riedstadt).

***Institutional system***

Unlike in Mainz-Laubenheim, the state government played a more important role and the regional government played a less important role. Besides the state and regional governmental organisations, the following actors were involved: the local inhabitants, companies and governments and the agricultural organisations.

Most actors did accept the problem of floods but not de need for intervention by the state Hessen. First of all, the problem was not caused in the state Hessen. Second, possible flooding risks could be prevented by a strengthening and heightening of the winter dikes. This form of non-acceptance was mainly represented by the local government and the agricultural organisations.

Farmers objected to give up grounds in favour of nature. As described in annex 2, ecological controlled areas need more ground surface for the same retention-volume. Furthermore the farmers objected to the development that the government does not use the existing nature protection areas in the floodplains before constructing new areas. Therefore, they interpreted the measures as not being fair.

The local actors, inhabitants, industries and the local municipality (and therefore the IHK) feared that the construction of a retention area influenced the groundwater level on the other side of the dike. On this side, not only housing areas were settled but also companies that are of regional importance, of which Mitsubishi Motors is one.

Most organisations that were involved tried to influence the process through formal instruments. This means participation by reacting on the different stages in the planning procedure. Furthermore, the municipality Trebur tried to create an alliance with other municipalities in order to get a negative advice of the regional-council (the organisation that advises the regional government in decision-making processes and that is formed by all members of the municipalities in the region). This worked, one of the municipalities that supported them was Riedstadt (interview Riedstadt). The reason for the support of the municipality Riedstadt was bipartite: the nature of the measure and the way the state government communicated the plan with the local governments.

The second resource of influence that was used by the actors was power combined with legitimacy. The company Mitsubishi Motors objected to the plan because of the fear of groundwater problems. Officially these objections took only place through the formal channels by the company and the IHK (interview regional government Hessen; Interview state government Hessen). It is also said (statement Mr. Dapp) that, if the retention-area would be constructed, Mitsubishi Motors would settle in another European region and close down the distribution centre in Hessen. This action would lead to unemployment and a decreased tax-income from the different governmental organisations (especially the local government is dependent on taxes from companies, which explains the attitude of the municipality council). Because of the economical decline in Germany the industrial interests can be interpreted as legitimate.

***The decision-making process***

The state government did not start the process with an introduction of the problem but with a plan, developed by an engineering agency, on which stakeholders could react. There was no communication in earlier phases with the stakeholders and the plan was, when published, very detailed. This lead to a situation where local parties felt threatened. Furthermore, local actors had the feeling that the state and regional government did not care for their interests (interview Riedstadt). All together this lead to a negative attitude towards the state government, and therefore all information provided by the state government was labelled as unreliable. In this situation it was very hard for the state government to translate the problem to a common problem and taking away the fear for ground water problems.

Because of the local resistance implementation of the plan would be very difficult. Furthermore the possible closing down of Mitsubishi Motors would have negative effects, that were especially in a period of economical decline non-desirable. Taking this decision would lead to negative effect during the elections. This lead to the decision of the state parliament not to construct the retention area and therefore a change of policy. They had the possibility to make this decision because they had not committed themselves to the construction of retention volume and the flooding risks for their region would already decrease as a result from other measures

Remarkable is that their were also nature conservation interests involved since the plan contained nature development. The actors concerned with nature protection did however not play important roles in the process. There are a number of reasons for this. First of all the little resources of influence that non-governmental nature protection organisations have to influence processes. Second, the state ministry concerned with nature protection is also the ministry concerned with agriculture (an interest that was conflicting with the plan). The conservative nature of the state government could lead to a preference to representing the agricultural interests.

## 7.5 Comparison between Mainz-Laubenheim and Trebur

*Interests and attitudes*
Both cases concern a rural area with housing and agriculture. However, both cases have a different spatial context. Trebur is located downstream of a nature protection area without a summer dike (Kuhkopf-knoblauchs aue) while Mainz-Laubenheim is located upstream of and economical centre. However, in both situations the local interests conflict with those of constructing the retention area.

A second difference concerns resource of influence of the representing organisation. In Hessen the local interests are represented by the municipality and an (important) industrial company. There industrial interests are legitimate, this was an important representative, also because this company had contacts with the government. In Mainz-Laubenheim the city-district council had no means and inhabitants were unorganised. Therefore there were no powerful players.

Concerning the actors that were in favour of the measure, the situation was the other way around. In Hessen the government had the competence to decide to construct. However, their

BATNA was better: they had the alternative not to construct. Would the state also be responsible for the safety of downstream areas, the outcome of this process would be different. Therefore, the definition of governmental responsibilities can be seen as influential.

In Rheinland-Pfalz the government did not only have the competence, but also legitimacy and personal skills as means. In Rheinland-Pfalz the BATNA was not better, because they had committed themselves to taking care of the safety of downstream areas through the agreement of 1977.

In both cases knowledge played an important role, but not as a resource of influence. The lack of knowledge and the mistrust of the inhabitants in the government had a negative influence on both processes. Therefore, looking for trust in one and another in the negotiation process could have led to a better outcome.

*Interaction in the institutional system*

Both processes took place through the formal decision-making structures. There were no structures of project groups in which non-governmental organisations could participate. The (regional and state) government assumed that the different departments (for instance the nature development department) were sufficiently informed about the interests of the stakeholders. The stakeholders themselves also stated that the contacts with the governmental departments are sufficient, and see these departments as a representative actor for their interests (interview NABU, interview Bauernverband). This however does not implicate that they feel that the government makes an honest weigh between the different interests. Remarkable is that a low degree of participation does not implicate non-acceptance.

Both processes had a different starting-point. In the framework of the obligation of constructing of a number of retention-areas, the government of Rheinland-Pfalz planned a decision-making process in which problem awareness and problem acceptance played an important role.
In Hessen they started with a detailed plan in stead of gaining trust and defining a common problem definition. This led to a different ground attitude towards the process. In Hessen the local interests felt left out of the policy development plans. However, it is doubtful if, in the absence of the BATNA and Mitsubishi motors, construction would have been cancelled. Therefore it is difficult to determine if the process organisation has indeed an effect on the outcome of these processes.

## 7.6 Synthesis

In the framework of high water threats in the past, an international agreement has been made between three German states and France. In this agreement two German states committed themselves to the construction retention areas. In the case study area this concerns the State Rheinland-Pfalz.

The case study concerns the construction of two retention areas, one in each state. In both states the processes were triggered by the occurrences of high water in 1993 and 1995.

In Hessen the process to construct failed due to a bad process organisation, the nature of the measure that was conflicting with economical interests, the alternative that they had to their disposal (not to construct) and the description of governmental responsibilities in the federal law. This law only makes them responsible for the safety of the inhabitants in the state, and not for downstream located states. The safety of their own inhabitants could also be guaranteed by strengthening the winter dikes.

In Rheinland-Pfalz construction was successful. First off all because of the different attitudes of actors towards the plan (and the instruments that these actors had to their disposal) as a result of the commitment and skills of the minister. Other politicians shared here objective because of the protection of economical interests. The absence of the responsibility for the safety of down-stream located areas was not a problem because Rheinland-Pfalz had committed itself to this responsibility in the agreement of 1977. The only alternative was to construct on another location, but there the same (or even more) problems would occur. This led to a more careful planed decision-making process on the side of Rheinland-Pfalz.

# 8. Conclusions regarding the case study

*How is the physical system of the Rhine constructed in the case study area**?***

The physical system in the case study is constructed of three elements that are regulated by different hydrological characteristics. The river that is the permanent wet cross section. The floodplains that are temporarily flooded during high water peaks. These high water peaks occur during summer and winter. During summer the summer dike is capable of preventing the winter polder from flooding. During winter the entire floodplain is flooded. The third spatial element is the land behind the winter dike. Although this is not directly a part of the spatial organisation that influences the discharge capacity, it does influence the spatial developments in the floodplains and the possibilities to expand the floodplains in order to increase the discharge capacity. Furthermore the land behind the winter dikes influences the use of the floodplains because the temporarily flooding of the floodplains can lead to an increase in the ground water level behind the winter dikes, and therefore damage to housing and industrial areas.

The land use in the floodplains concerns mainly agricultural and ecological forms of land-use, because these forms can endure a periodical flooding. Agriculture has settled in the part of the floodplain that is protected by a summer dike. In the unprotected areas and on the riverbanks ecological development takes place. In some former Rhine arms large unprotected areas (due to a breaking of the summer dike) are located in which nature development takes place.

Industrial interests and housing takes place behind the winter dikes. Concerning industries this mainly concern companies with a large ground surface, that settled in this region because of its central location but relative low ground prices. In the floodplains some industries are located that have settled there before 1968.

The river itself is mainly used for navigation and to a smaller extent ecological development (old Rhine arms).

*How is the German institutional system regarding river management of the Rhine in the case study area constructed, which actors are involved, what are their characteristics and how are they related to one and another?*

*The socio-economical system*
The socio-economical system in the case study area concerns mainly agricultural and ecological forms of land-use, because these forms can endure a periodical flooding. The organisations that are related to these forms of land-use have small influence on the development of these areas, due to their little economical surplus value. Although both stakeholders have a formal right of participation in processes, they both complain to feel “unheard”. Remarkable is that the nature organisation make little use of the media. There comments concerning the compensation principle could place the functioning of this principle on the public agenda. However, they do not assess this power. Concerning agricultural interests, the power of ground possession is smaller than in the Netherlands since there is little scarcity in

Germany. Due to the large supply of rural areas, there is also less appreciation of agricultural lands than in the Netherlands.

Industrial interests and housing takes place behind the winter dikes. Their interest is to maintain a safe situation and possibilities to expand. Regarding the issue water management their interest is to prevent ground water problems as a result from measures. Industrial interests are legitimate due to the bad economical situation in Germany. Furthermore, large industrial companies often have good contacts with governmental organisations and administrators (partly informal contacts). This has been confirmed by the IHK. Housing is not represented in decision-making processes by an NGO, but mainly by local governments. The local governments have the responsibility (set in the law) to maintain a safe situation for their inhabitants. Furthermore, local governments often want to expand in order to increase their incomes of taxes.

The river itself is mainly used for navigation and to a smaller extent ecological development (old Rhine arms). The interests of navigation are represented by a governmental organisation: the WSV. There this is a national organisation and navigation is of national economical importance, this is a very powerful player. They have a certain status in processes, have decision-making rights in processes and a large amount of money to their disposal. However, they have little interests in developments on the land-side and therefore are little involved in the decision-making processes.

*The administrative system*
The administrative system is divided over the water-governments and spatial governments. The responsibilities of the governments are divided over four governmental levels: the state, the region, the district and the municipality. Concerning the developments of discharge on a regional level, the state government and the regional government are the most influential governments because they have the power to decide about measures. The interest of the water government concerning the discharge capacity of the Rhine is mainly to maintain the safety of the region: this is the area between their administrative borders. The interests of the spatial government are creating a good living and investment climate. The spatial policy is influenced the economical decline that is the result from the unification of East and West Germany. This has led to a high legitimacy of economical interests in order to decrease the unemployment.

*Relations*
Within the institutional system relations are to a large extent formalised. Organisations with the same land-use are organised and have contacts with the governmental organisation. Between organisations with different land-use interests little however little relations take place. Exemptions to this are the economical actors that claim to have good contact with the different governmental organisations.

The above is reflected in the figure on the next page.

| Organisation | Interests in relation to the measures | Resources of influence |
|---|---|---|
| WSV | • Keeping the river navigable and therefore a water level that is between +2.10nap and +6.50 nap.<br>• Prevention of sedimentation.<br>• Prevention of side-streams that can affect the stability of the river. | • Decision-making rights in all procedures that interfere with the cross-section of the river.<br>• Decision-making rights in all procedures that concern distracting water out or draining water into the river.<br>• Participation-rights in all procedures that influence the capacity of the floodplains.<br>• Status of federal government.<br>• Representation of economical interest. |
| State government | • Protecting inhabitants against flooding.<br>• Restoring the safety to a HQ 200 (both states)<br>• Reconstructing a retention capacity of 60 mln. M3 (Rheinland-Pfalz).<br>• Economical growth.<br>• Increasing awareness of flooding risk. | • Right of giving approval in all procedures.<br>• The right to point out locations for retention areas. |
| Regional government | • Protecting inhabitants against flooding.<br>• Restoring the safety level of the land behind the winter dikes to a HQ 200 (both states)<br>• Reconstructing a retention capacity of 60 mln. M3 (Rheinland-Pfalz).<br>• Economical growth.<br>• Increasing awareness of flooding risk. | • Decision-making rights concerning all changes in land-use in the floodplains (water department)<br>• Pointing out reservation areas for retention-areas (spatial department).<br>• Making decisions concerning height of winter dike (water department)<br>• Making decisions on water distraction and draining in the Rhine and the groundwater.<br>• The right to participate in all procedures on local and state level.<br>• Financial means. |
| Local government | • Maintaining all economical functions in the municipality (industry and agriculture).<br>• Protection of inhabitants against flooding.<br>• Prevention of groundwater problems | • Decision-making right of the maintenance of summer dike.<br>• Participation in all spatial procedures. |
| Nature protection organisation | • Protection of marginal vegetation in floodplains.<br>• Vegetated riverbanks.<br>• No sudden flooding of floodplains.<br>• Possible expansion of natural areas in floodplains. | • Participation in all spatial procedures.<br>• Media support for ecological interests.<br>• The obligation of governments to compensate decrease in natural surface. |
| Economical interests | • Protection of current economical companies in or near floodplains and possibilities to expand.<br>• Maintenance of navigability of the Rhine<br>• Reasonable ground prices and therefore not large demands for nature protection. | • Bad economical climate and therefore public acceptance of interest.<br>• Social contacts with public representatives in the governmental organisations.<br>• Participation in decision-making procedures concerning all spatial developments. |
| Agriculture | • Maintenance of agricultural surface in floodplains and behind winter dikes.<br>• Maintenance of summer dike.<br>• No increase in the groundwater level. | • Organisation in official interest group and contacts with local government.<br>• Possession of grounds. |

*Figure 22: overview of the involved actors, their interests and their means*

*Which elements are the driving forces behind the processes in the institutional system and therefore behind the influence of the social organisation on the spatial organisation?*

*Was the decision-making process more integrative or distributive, and what was the influence of the nature of the decision-making process on the outcome therefore on the spatial organisation?*

*As far as* can be concluded in the end of the process, the decision-making process in Rheinland-Pfalz was more integrative. However, this is mainly based on the information-campaign set up by the ministry concerned with high water protection and on the interviews with local governments. Concerning the interests of local inhabitants both processes took little care of the local concerns. Furthermore, both processes followed the formal procedures instead of involving actors in an early stage. What the influence of the process organisation on the outcome was is also hard to say. Both situations had other influential factors that more directly influenced the outcome.

*How did the processes in the formal decision-making process and informal decision-making process influence one and another, and what was the influence on the outcome and therefore on the spatial organisation?*

In Hessen there were obviously processes outside the formal process: the situation concerning Mitsubishi motors and the co-operation between different governmental organisations, which influenced the outcome. In Rheinland-Pfalz the processes outside the formal process mainly concerned the resistance of farmers and therefore a redefinition of the problem.
However, because all TOB's can react on al reactions can be part of the formal decision-making process. Only concerning the action of Mitsubishi motors it is doubtful if they would have shown this behaviour in *the formal process.*

*How are processes in the institutional system influenced by the characteristics and actions of actors?*

The interests and resources of influence were very influential. In Hessen the actor that were against constructing had important instruments and the initiator had a good BATNA: not constructing. The government had this BATNA not because they committed themselves to taking care of the safety of downstream areas by signing the agreement of 1977. The BATNA's of the regional and state government are very important because they are the most powerful players. The powers of local governments depend on their size. Large towns are powerful while small villages have relatively little power.

A second important resource is legitimacy that derives from the cultural sub-system. Due to the unification of East and West Germany, economical interests are have a high form of legitimacy. In this matter the spatial context of the measure is of importance: how does the measure relate to the location of economical interests.

The last important resource of influence is status. Governmental organisations have a certain status that is respected in procedures. The procedures leading in the policy making process. The decisions made in these processes are respected and actors will not soon disagree with the decision of a high governmental organisation.

*How are the processes in the institutional system triggered or influenced by developments in the spatial system?*

The trigger of both processes was the flooding risk that occurred in the nineties, which led to the awareness of the need of taking measures.

Second, as stated above, the spatial context of the measures influenced the characteristics of actors. It determined the attitude towards the measures of the different actors. Second, in Hessen the presence of an uncontrolled nature conservation area led to an alternative. This influenced the attitude of local farmers and therefore the local government towards the measure.

*How are processes in the institutional system triggered or influenced by external audits?*

The only trigger was the policy development of the WWF. This organisation triggered the initiators of the process in Hessen. During the process there were no actual external audits.
Besides the process also influenced by aspects of the social organisation that can be influenced by the participants themselves. A part of the German culture is not only to respect governmental decisions. The government is also partly mistrusted: this led to the non-acceptance of information and therefore in Hessen to non-construction.
Second, the political sub-system influenced the process. The division of competencies over the different administrative levels influenced the combination of attitudes and resources of influence. Furthermore, the division of governmental responsibilities at the same governmental level can led to another weighing of interests: the example of this is the ministry of agriculture and nature protection that did not play an important role in the Hessian process.

*Based on the above: how do the characteristics of the actors in the institutional system and the processes between these actors influence the spatial organisation regarding the discharge capacity of the Rhine, how does the social organisation and spatial organisation trigger these processes?*

Institutional system ➔ Social and spatial organisation
The institutional system results in a (more or less) conservative influence of the social organisation on the spatial organisation. There are relatively little changes, and when changes occur they are the result of process elsewhere or decisions on a higher governmental level. The region itself has relative low dynamics. This conservative influence is also reflected in the spatial policy. The policy decisions of the government are often implemented and there is little resistance. This is partly due to the status of the government. However, also the availability of

ground surface (there is little scarcity) leads to a situation where spatial changes have fewer effects: it is relatively easy for farmers to buy new grounds and the countryside is less scarce and therefore less appreciated by the inhabitants of cities. This compared to the Netherlands, where there is scarcity of agricultural ground, and more resistance against the decrease of recreational areas exists.

The resources of influence and the attitudes that they are related to are influential. The most influential resources are power (competencies & status), legitimacy (economical interests) and the BATNA. In both cases these attitudes related to these resources corresponded with the final outcome of the process.

Concerning the process organisation it is difficult to draw conclusions. First of all because of the limited information concerning the process. Second, the available information was hard to judge because the was no *ceteris paribus* situation.

Social and spatial organisation ➔ institutional system
The spatial relation (ground water relations, upstream/downstream) influences the effects of measures on the actors. The spatial organisation also influences the alternatives for the measures and therefore the attitudes toward measures (is there a better alternative?).
Besides the spatial context also the culture influences the attitudes of actors: information is judged on its sender.

The influence of the spatial context on resources mainly concerns the power of ownership of agricultural lands. The availability of agricultural and wastelands changes the value and the public appreciation of agricultural land. Second, the spatial organisation influences the BATNA's of actors.

The (cultural sub-system of the) social organisation mainly influences the legitimacy of the economical interests and the status of higher governmental organisations. Furthermore, the political sub-system influences the competencies and responsibilities of governmental organisation. These competencies and responsibilities are an important resource.

Concerning the process, the only influences are the floods (spatial developments) that triggered the processes and the WWF report concerning Trebur (social organisation).

# 9. Modelling the cases

## 9.1 Introduction

This chapter compares the design of STORM the conclusions of the case studies. The comparison is needed in order to conclude if STORM is capable of representing the (important) elements of the German river management system and the relations between these elements. Therefore, the chapter is divided in four sections. A comparison between the case and STORM concerning the design and working of the spatial organisation. A comparison between the case and STORM concerning the design and working of the institutional systems. A comparison between the case and STORM concerning the design and working of the processes between these systems in STORM..

## 9.2 STORM: The spatial organisation

Within STORM the spatial organisation is reflected as a conceptual computer model, that represents the environment in which human behaviour takes place. A conceptual model is constructed of (clear formulated) objects and the relations between these objects (Geurts & Vennix, 1989). Concerning the issue spatial planning these objects can be both real objects and indicators. In Storm, this conceptual model is reflected in a map. The map contains a number of objects: a river, a number of towns/villages, floodplains, and protected land (behind the dikes). On its turn, each object is translated in parameters. The river for instance is translated in flooding risks and water level. The town is translated in number of inhabitants, economical growth and unemployment rates.

The changes in the conceptual model (that take place as a result from actions from the participants) are reflected in changes in the parameters. For instance: a decline of the ground surface of the floodplains can be translated in a higher flooding risk. Or: the building of a industrial area leads to economical growth and less unemployment.

Besides changes (of the conceptual model) as a result from the actions of participants also changes take place as a result from developments outside the model. These are called scenarios. The reason to “program” such scenarios is that a group of participants can ignore or oversee certain problems or pays too little attention to the discussion about them. By implementing such scenarios (such as global economical decline) participants are forced to overlook their behaviour and change it. Examples of scenarios are high water peaks or economical decline.

The spatial organisation in the case study can be modelled and the objects translated in parameters. The model can be abstracted in the three elements: the Rhine, the floodplains and the protected land. Important parameters for the protected land are flooding risks, ground water levels, damage potentials and economical growth.

## 9.3 Institutional system

### *STORM*

Management simulations translate the characteristics of actors in role description models. A role description model consists of components, which represent those characteristics of actors that influence conceptual model. In order to define which components should be used for the description of actors, the interaction between the physical system and the institutional system should be analysed. Examples of components are: budget, decision-making powers, interests and objectives. Informal relations are not modelled but take place outside the computer model while simulating.

In STORM the actors consist of governmental organisations on local, regional and national level. Each organisation has a set of objectives and criteria in order to measure the results of the different actions. The objectives only concern objectives relating to the area.
In order to achieve the given objectives, the organisations can take several actions. There are three groups of actions:

- River training measures: these are measures that have as primary goal the control of the river, and correspond to the actions that are described in annex 2.
- Managerial actions: these are measures that have as primary goal the control of the land cover such as natural succession and agricultural management pasture.
- Physical planning measures: these are measures with a physical planning character such as the construction of a camping site (Schmidt, 1998).

Before an action can be implemented the institutional requirements have to be fulfilled and permits have to requested from the issuing government (Schmidt, 1998). In this matter there is no role for non-governmental organisations. Their demands are translated in scenarios (section 9.2), such as a demand for recreation or a demand for houses. However, they have no means to influence the process. The influence of governmental organisations is translated in the role description system as described above. The computer screen shows the spatial development of the river and floodplains (the conceptual model) and the effect of actions on the value of parameters. For example: changing a agricultural area into a housing area changes the map on the computer screen (green becomes red). Second, the values of the parameters economical growth, inhabitants, damage potential, etceteras change.

### *The institutional system in Germany*

*Actors*
Remarkable is that STORM only represents the governmental organisations. NGO's are translated in demands, such as a safe housing area. This way of modelling hides the emotions and prejudices that often accompany these demands. Therefore it will be difficult to model the reaction of these NGO's when there needs are not satisfied. An example from the case study is that the NGO's demanded prevention ground water problems in housing areas. However, the inhabitants did not accept the solution of the government because they mistrust the government. In order to model this, a careful analysis of the institutional system is needed in order to get a good representation. During the simulation participant will think they solved the problem while in reality inhabitants are still angry.

*Interests*
Most interests and resources can be modelled. Objectives can be translated in parameters and participants gain insights in the differences between their objectives and the model. However, the parameters that represent the interests are dependent on a large number of objects. For instance, the attitude of farmers towards a measure depends on ground prices. This however is not a fixed price but dependent on other developments, such as the expansion of the airport. This makes the model very complex: each parameter is dependent on a large number of other parameters. Second, as described in the theoretical framework, not all actors have clear objectives. They become aware of them when something changes. In a computer fixed model, it is hard to implement these objectives and reflect the right parameters in a short amount of time.

*Resources*
In the case it became clear that one of the most important resources is legitimacy. The legitimacy of economical interests can be modelled by showing the economical growth and employment and introduce scenario: for instance the demand for economical growth during elections. Also decision-making rights are important. This can be modelled by obliging participants to get approval of others before implementing measures.

It is more difficult to get a good representation of the resources personal skills, networks and power. Mainly because it is doubtful if all participants will use the resource power in order to achieve their objectives. For instance the example of Mitsubishi motors and dispossession of grounds by governmental organisation. A good representation of the personal skills depends on the representative of an organisation, therefore a careful selection of participants is needed. Finally, the coming together to play the simulation can create relations that were not there before. This means that also relations or networks can be different in the simulation than in reality.

*Processes in the institutional system*
Simulating decision-making processes influences the process. When the simulation is initiated by an independent research organisation, the information will be sooner accepted than in reality. This means that the simulation is not fully representative. Second, the participants get an overview over all interests and elements important for the decision-making process (the computer provides this overview). Providing this information and overview influences the knowledge of actors and therefore their behaviour and attitude and the nature of the process: it becomes more integrative.

In order to examine the influence of the nature of decision-making different rounds should be played. Rounds in which participants only see the information and parameters that they see in a real life situation. But also rounds in which they get insights in the interests and objectives of others and all consequences of their behaviour. The first gives information about the present intricacies of river management. The second round gives information about the effects of process-management. Concerning research-objectives: these rounds form the basis for examining the influence of decision-making techniques on the outcomes of these processes.
The different rounds can be also used in simulations that aim at supporting decision-making processes.

The processes between actors in the institutional system partly take place outside the modelled environment. The registration of these processes is important for the insights in the intricacies of river management. Therefore the mediator (the person that co-ordinates the simulation) should be skilled to signal and register these processes. Also the resources “networks” and “personal skills” becomes clear outside the modelled environment.

A second part of representing the decision-making process in a modelled environment is that an action can only be taken when modelled. When actors want to behave in another way, first the model has to be adjusted. This reduces the dynamics of the model.

### 9.4 Relations between the spatial and social organisation and the institutional system

Within STORM the effect of behaviour and scenario’s (institutional system) on spatial organisation becomes visible in the values of the parameters and in the map on the computer screen. The changing parameters trigger the behaviour of the participants (such as high water peaks or (spatial) demands from NGO’s). The behaviour of non-participating interests can be modelled in scenario’s (that can be related to certain parameters).

In the model it is hard to design external audits (social organisation) because it is hard to predict these external audits. There the model represents a long-term development it is likely that they occur during the decision-making process or implementation phase. This can concern sudden processes, for instance an animal disease, but also gradual processes like changes of the prevailing norms and standards (cultural sub-system). Contrary to external audits the internal audits can be implemented. For instance, simulating the developments when the state government is made responsible for the safety of downstream located areas.

Concerning the case study area the most difficult influences to represent are those of trust and legitimacy. This research already mentioned some aspects of legitimacy, but there are much more parameters that influence the opinion about policy and the process behind this policy. Again, a careful research concerning these prevailing norms and standards are needed for a good representation of the intricacies of river and floodplain management.

# 10. Conclusions and recommendations

## 10.1 Conclusion

The problem definition of this research is:

> *How do the characteristics of the actors in the institutional system and the processes between these actors influence the spatial organisation regarding the discharge capacity of the Rhine, how does the social organisation and spatial organisation trigger these processes, and is STORM capable of simulating these characteristics and processes?*

The spatial context and the culture determine the attitudes of actors towards measures or developments that influence the discharge capacity. When these change gradually, there is little reaction of the institutional system. When these change in a high rate, like high water peaks or governmental measures, the institutional system takes action. Therefore: occurrences trigger the processes in the institutional system.

Their attitude towards the developing of the spatial organisation depends mainly on the spatial situation and therefore the effects on their interests and the cultural climate. In governmental organisations the attitude is also determined by governmental responsibilities settled in the law, like the responsibility for safety. Dependent on the attitudes and/or objectives and the available recourses, the actors take actions to pursue their objectives. In this matter the following resources are the most influential: power (status and competencies), legitimacy and the BATNA. The influence of process organisation is difficult to judge, but likely of little influence. The outcome of the processes in the institutional system are translated in policy that co-ordinates the spatial development.

An essential element of STORM is to model the environment and represent the development of this model in parameters. In this matter a number of objects and their relations can be modelled to a certain extent. The German situation is however very complex, which makes it hard to create a representative model. An elaborated analysis concerning the different subjects is needed, for instance economical and cultural issues. The less parameters are represented in the model, the less value the model will as a research instrument. In this case it will become more suitable for supporting decision-making processes by creating problem awareness. However, the situation can never be completely modelled since there are certain developments that can not be predicted. Concerning the research objective it should be noted that the model could also be used to research the effects of different forms of decision-making processes.

Second, in order to get a good representation not only an elaborated analysis is needed, but also good process management. A part of the process will not be registered in the system but is relevant for explaining the development of the discharge capacity. Therefore it is of great importance to monitor the process that takes place outside the computer model. In this matter the personal skills of the mediator (the person that leads the simulation) are of great

importance. This process-manager should also take care that participants will show the real behaviour. It is doubtful is a process-manager is capable of motivating all participants to show this behaviour.

***The final conclusion therefore is that STORM can represent an abstracted model of the German river management situation. A more detailed model (that is needed for research) requires an elaborated analysis that supplies the research data. However, this model will be too complicated to play. The abstracted model is mainly suited for supporting decision-making processes.***

### 10.2 Recommendations

As noted in the conclusions the subject is complex andt there are enough subjects that are important for translating the model in parameters that need further research. It is recommended, in order to get insights in the intricacies in river management through management simulation, to conduct these researches.

However, the need for these researches depends on the objective of STORM. Insights can also be gained by analysing the elements through other forms of research, like interviews and literature. The designers should ask themselves what the surplus value is for modelling these elements for research objectives. It could be more interesting to design a model that aims at supporting decision-making processes and judging the construction of the current governmental river management system. Such a model can be more abstracted. A possible conclusion of this model is that governmental responsibilities should be arranged at different levels. Furthermore, these models can also analyse the surplus value of process management in decision-making processes.

# 11. Literature and interviews

## 11.1 Literature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Mrs. Brendel and mr. Thorn
Industrie und Handelskammer Darmstadt
*Economical interests*

Mr. Christ
Ministerium für Umwelt und Forsten
Rheinland-Pfalz.
*Water management at state level*

Mr. Domus and mr. Unger
Umweltamt & Bauamt
Gemeinde Riedstadt
*Municipal interests*

Mr. Egeling
Naturschutzbund (NABU)
Group Bingen-Gaulsheim
*Nature protection interests*

Mr. Gieseler
Umweltamt
Regierungspräsidium Darmstadt

*Water management at a regional level*

Mr. Hammer and mr. Milbradt
BASF Aktiengesellschaft
Abteilung Behördenverkehr und Liegenschaften DWB
*Economical interests*

Mr. Herbst
Bund für Umwelt und Naturschutz
Ortsverband Riedstadt e.V.
*Nature protection interests*

Mr. Iven
Wasserverband Hessisches Ried
*Water extraction interests and agricultural interests*

Mrs. Kappler
Riedwerke Kreis Groß-Gerau
*Water extraction interests*

Mr. Kramm
Gebietsagrarausschüß
*Agricultural interests*

Mr. Löw
Ministerium für Umwelt, Landwirtschaft und Forsten
Hessen
*Water management interests at state level*

Mr. Steitz and mr. Lorenz
Wasser und Schiffartamt Mannheim
*Navigation interests*

Mr. Webler
Ortsbeirat Mainz-Laubenheim
*Municipal interests*

# ANNEX 1:Management simulations and STORM

**What is management simulation?**

In order to explain the concept management simulation the term simulation deserves some elaboration. Simulation is an attempt to abstract and reproduce the central characteristics of a system in order to understand, experiment and predict the behaviour of this system (Duke in: Caluwe a.o., 1996). Systems are objects and the relations between these objects. Systems can vary from a technical system to a social system.

In a management simulation the system of interaction between actors and the effect of this on an object is being simulated. Every actor has its own objectives concerning an object and means to influence this object. By simulating the behaviour that they show to reach their objectives, insights can be given in how an object develops during time. Because in real life the behaviour is often limited by a number of rules, these rules are also valid in the simulation. Management simulations are also referred to as role plays or simulation games. Because both names imply that the purpose of the simulation is to win, this report will use the term management simulation.

Management simulations are often constructed out of a number of rounds. Between these rounds the actors can evaluate their behaviour. Also they can choose to experiment with new forms of behaviour. In this matter the game-leader has an important function. He has to take care that participants reflect their own behaviour and are capable of making the translation of the game to reality (Caluwe a.o., 1995).

**Applications**

Management simulations can have a number of applications. Different authors distinguish these functions in another way. In this report the subdivision of Mayer[1] will be used. He distinguishes five applications: training, research, learning, intervention and exploring.

***Training***

In training a management simulation is used to learn participants new skills, for example a new procedure within an insurance company.

***Research***

Research aims at studying the behaviour of a group. The modelled environment in which they take their actions should be as realistic as possible in order to create a realistic simulation of their behaviour in real life.

[1] The division in five functions is based on an interview with Mr Mayer, which is employed at the faculty for policy analysis and system engineering at the Technical University of Delft.

***Learning***

Learning concerns the creating of understanding among participants about situations and other participants. The concept learning is close related to the concept knowledge. Actors generate knowledge by interpreting their observations. The way an actor interprets the information depends on the information that he already has to his disposal. Because all actors have other information, each actor interprets the same situation in another way, varying from “a problem situation” to the “desired situation” (van Woerkum, 1995). The function learning can be sub-divided in mirror and window functions:

*Mirrors*
Within a management simulation participants exchange information by pursuing their role specific objectives. They gain insights in the objectives of other participants and the extent to which these objectives conflict or correspond with their own objectives. The simulation does not only reflect on the different participants, but also on the co-operation process. When participants look back on the way they made decisions and analyse mistakes, they can improve these processes in the future. This aspect of learning is called the mirror function (Caluwe a.o., 1996)

*Windows*
Furthermore, a management simulation confronts the participants with the results of their behaviour in a very short time, in contrast to reality in which it may take months or even years before the impact of behaviour becomes perceivable. This way the participants can become aware of consequences of their behaviour: a mirror. When these consequences are not desirable, participants can adjust their behaviour in reality.

***Intervention***

Where learning only tries to create understanding among the participants, intervention goes further: it also tries to change the behaviour of these participants (Caluwe & Geurts, 1996; Mayer).

One of the key aspects of intervention is cultural change. The culture of a group or an organisation is formed by the attitudes and behaviour of group members. In the process of changing the behaviour of the group-members information and knowledge play an important role. This can be explained by the theory of planned behaviour of Ajzen and Madden, which is discussed in the figure on the following page.

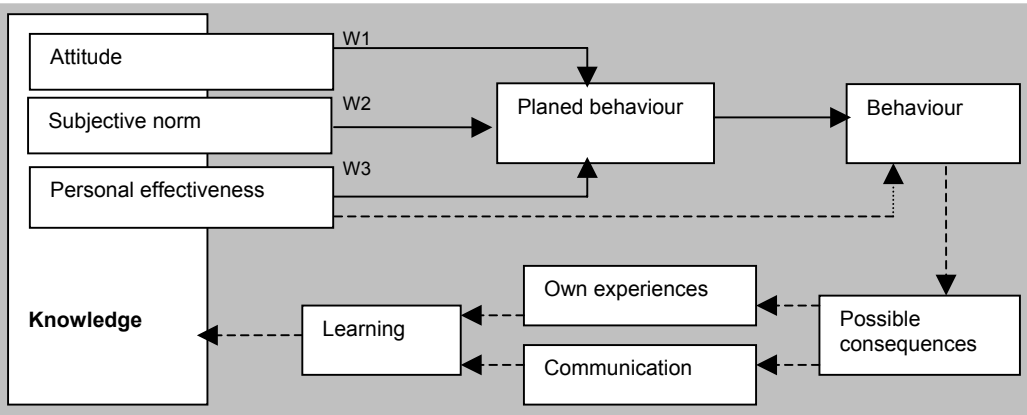
For a sustainable change of culture, management simulations should be used in combination with other tools that support group-members to maintain the changed behaviour (Caluwe a.o., 1996) .

***Exploring***

New policy systems are often designed at a governmental level. Within the designing process there is a danger that the designers have failed to foresee problems and that the policy will

create (unintentionally) new problems or will not generate the desired effects. By simulating the implementation of a new policy system weaknesses can be identified. The process of identifying weaknesses has to take place in co-operation with the people that participated in the simulation, because they experience other problems than the policy designers.

Within exploring also new alternatives can be developed by the participants, which can be explored in the system. A weakness of this system is that the relations between objects have to be implemented at the start of a simulation. Therefore, a management simulation can not reflect directly the consequences of these new alternatives.




Planed behaviour

Knowledge influences the behaviour of actors within systems. This can be explained through the model of planed behaviour (Ajzen & Madden). In this model behaviour is the product of the attitude, the subjective norm and the personal effectiveness. The attitude is the reflection of the opinion about a certain kind of behaviour of an actor. This opinion is based on the possible effect of the behaviour. When the effect is valued negative and the chance that the effect occurs is big, the actor will have a negative attitude. The subjective norm is the pressure around an actor to behave on a certain kind of way. The subjective norm is based on the opinion of others and the attached importance to this opinion. The personal effectiveness is based on the expected effort that is needed to change the behaviour.

Not all elements in the model have the same importance. Therefore every element is valued (W1, W2 and W3), dependent on the situation. If the planned behaviour is being translated into actual behaviour depends on the physical constraints of an actor.

People can learn by from the consequences of certain behaviour. The learning can be based on personal experiences, but also on experiences from others (communication). In general a personal learning experience is more sustainable than communication.

*Theory of planned behaviour (Van Woerkum & Kuiper, 1995)*

**Participants**

The selection of participants depends on the objective of a management simulation. When a management simulation aims at learning, a target group is often defined. When the target group is relatively small, all members can participate in the management simulation. When the target group consists out of a large number of individuals, representatives should be selected. These representatives should be well informed about the interest and situation of the group they represent. In this matter it is important to notice that the general interest of a group can differ from sub-interests. Furthermore, representatives should also be able to communicate his learned experiences to the group they represent.

When a management simulation aims at the changing of behaviour (intervention) it is more difficult to work with representatives. As explained above, the changing of behaviour is related to learning and knowledge. Learning can take place in different ways. In this matter we distinguish learning by experience and learning by telling. Learning by experience is more sustainable that when someone tells you that you have to change your behaviour.

When a simulation aims at exploring the selection of players is based on other arguments. In order to simulate how a new form of policy will function in reality, and what side effects will take place, all relevant actors have to be involved. An actor is an acting unit. When an actor has a certain interest in an area, they are called stakeholders. Stakeholders can be one person or a collective. Besides stakeholders there are also decision-makers. Decision-makers are those actors that are authorised by the state to make decisions, these are mainly governmental organisations.

Which actors are relevant, depends on the objective of the simulation. When simulation aims at testing if a policy will reach its objectives, it is only necessary to involve those actors that influence the system. However, when a simulation is set up to improve the contents of a policy, it is also relevant to involve those actors that are not able to influence the system, but are influenced by it.

**The design of management simulations**

Management simulations are constructed of three elements: the conceptual model, the role description system and the rules. These three elements will be discussed below.

***Conceptual model***

A conceptual model represents the environment in which human behaviour takes place, for instance the organisation structure of a hospital. A conceptual model is constructed of (clear formulated) objects and the relations between these objects (Geurts & Vennix, 1989). Concerning the issue spatial planning these objects can be both real objects and indicators, for instance a highway and noise pollution.

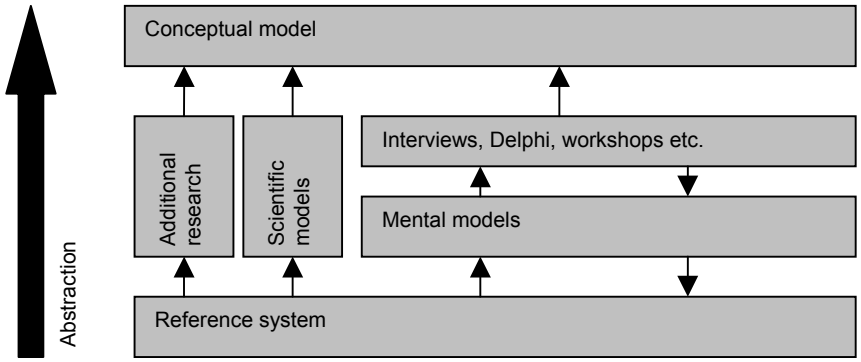
The conceptual model changes as a result from the actions of participants or by developments outside the model, which are called scenarios. The reason to “program” such scenarios is that a group of participants can ignore or oversee certain problems or pays too little attention to the discussion about them. By implementing such scenarios, participants are forced to overlook their behaviour and change it.

Within conceptual models the complex reality is reduced. The need for reducing the complexity is bipartite. First of all participants have a limited capacity to process a great amount of information. Second, not all objects (of the model) have the same level of detail. In order to identify relations, the model should be designed based on those objects with the smallest detail. The process of reducing the complexity is called abstraction[2]. What abstraction level is most

[2] Another way of reducing the complexity is by dividing a problem in to parts, and modelling each part individually. Because relations between the objects in a system are of great importance for the behaviour of a system, it is better to study the system in total.

effective, depends on the objective of a simulation. Practice has shown that metaphors (with a high abstraction level) are suitable for simulations that aim at motivating and raising awareness. For simulations that aim for a higher purpose (learning or intervention) the model should show more similarities with reality (Caluwe a.o., 1996). In a simulation that aims at exploring the model should correspond to a large extent with reality. The construction of conceptual models is based on three forms of information.

Mental models are individual and subjective perceptions that people (unconsciously) construct on the basis of their personal experiences. Mental models contain a lot of information, which is often incomplete and hard to exchange. For constructing a conceptual model, three sorts of mental models are relevant: mental models of decision-makers, mental models of stakeholders and mental models of experts (Caluwe a.o., 1996).




*Participative model construction*
*Source: Geurts and Vennix, 1989)*

Mental models are the most important basis for the conceptual model. First of all they are important to create a holistic perspective of a complex problem. Second of all they promote the acceptance of the conceptual model. This can be illustrated with the following example. “When a planner walks into the room with a model on his computer that he has made up himself, the chances are slim that his audience will recognise this particular microworld. If the target group is a management team, the starting model must be the sum of their individual models ”(Caluwe a.o. 1996; Geurts and Vennix, 1989).

Because the mental models do not contain all the necessary information that is needed for the analysis of a complex problem, and because of the difficulties with exchanging mental models, it is often necessary to complete the information from the mental models with information from other sources. This can be information that that is generated from existing scientific models and theories and additional research.

***Roles and role description***

The participants in a management simulation play a certain role. This role can be the role that they play in reality or it can be the role of another (member of a) group or organisation. Which role an actor plays depends on the objective of the simulation. For example, in a simulation that is focussed on improving the service of a company, it can be very useful to put the employees of this company in the role of a customer (Caluwe a.o., 1996).

The role of a participant is described in a “role description model”. A role description model consists of components, which represent those characteristics of actors that influence conceptual model. In order to define which components should be used for the description of actors, the interaction between the physical system and the institutional system should be analysed.

***Rules***

Rules are the preconditions related to the actions of participants. Two kinds of rules can be distinguished: rules that can be changed during the game and rules that can not be changed during the game.

If rules can or can not be changed depends on if they are part of the policy that is tested. This will be explained by in the following example. A management simulation is organised in order to test a new decision-making system for licensing the storage of fireworks. The decision-making system is constructed out of a number of rules that have to be observed before a decision can be made. When it turns out that these rules are not effective, participants can change the rules and the adjusted system can be simulated. When rules are not a part of the system that is tested but are determined by external factors, they can not be changed.

**The working of management simulations**

The first step is to select participants. In a simulations that has the objective to research the behaviour of a group all members of a group have to participate. In simulations that aim at facilitating decision-making processes all relevant actors have to participate. When actors concern interest groups this means that representatives have to be capable of representing the interests of a group and to communicate the results to the group. There is a limit to the number of participants of a simulation. The optimum is seven and the maximum is twelve.

When all participants are selected the simulation can start. In most simulations the computer plays an important role. By interacting within the model and continuing the own behaviour, the existing way of interaction between the participants is simulated. By visualising the effect of this behaviour, problem awareness can be created. The so-called mirror function. In this matter it if of importance that the mediator reflects the outcomes with the group in order to create awareness how their behaviour contributes to the problem. When the problem is accepted, participants can choose to solve the problem. They can formulate themselves a problem definition and look for alternative solutions. Each solution can be represented in possible effects. By discussing which effects are desirable and which effects are not, a common set of criteria can be created. This way all solutions can be weighed.

In the simulation the mediator plays an important role. He or she has to create learning moments, insure that participants do not overlook crucial points, create commitment amongst participants, etceteras.

**STORM**

***The design***

In STORM the conceptual model is a section of a river that runs through four municipal areas. The participants consist of governmental organisations on local, regional and national level. Each organisation has a set of objectives and criteria in order to measure the results of the different actions. The objectives only concern objectives concerning the area.

In order to achieve the given objectives, the organisations can take several actions. There are three groups of actions:

- River training measures: these are measures that have as primary goal the control of the river, and correspond to the actions that are described in annex 2.
- Managerial actions: these are measures that have as primary goal the control of the land cover such as natural succession and agricultural management pasture.
- Physical planning measures: these are measures with a physical planning character such as the construction of a camping site (Schmidt, 1998).

Before an action can be implemented the institutional requirements have to be fulfilled and permits have to requested from the issuing government (Schmidt, 1998). In this matter there is no role for non-governmental organisations. Their demands are translated in scenarios, such as a demand for recreation or a demand for houses. However, they have no means to influence the process. The influence of governmental organisations is translated in the role description system as described above. The outcomes of STORM show the spatial development of the river and floodplains when actors proceed their own behaviour.

***The working***

In the current design of STORM participants do not make a further step to reach a common floodplain management in order to prevent negative effects that occur with the current behaviour. Therefore the design is also not suitable, because objectives are still individually formulated. In order to prevent that participants only persuade their role specific objectives, for decision-making group-objectives should be formulated. This prevents that a competitive atmosphere will be created.

Because the objectives, criteria and effects on the physical module are already programmed in the computer it is rather difficult show the effects of new actions or criteria. This means the research on which the design is based has to be very thoroughly and all possible actions and criteria have to be already formulated. Furthermore when some actions or criteria are not formulated, this could lead to a misrepresentation of the current situation. Participants only take to actions that are defined but overlook those actions that they take in a normal situation but are not formulated. STORM tries to prevent such a situation by letting participants formulate, before the beginning of the simulation, their own strategy.

**Synthesis**

Management simulations are mainly suited for the supporting of decision-making processes in complex environments. They do this by giving participants insights in the complexity of a decision-making field. However, the management simulation does not offer solutions.

Management simulations are constructed out of three elements: roles, rules and a conceptual model. In order to define these three elements in a way that they are recognisable for all participants, they have to be developed in an interactive way with participants.

- Roles can be defined on all characteristics of a participant that can influence the development of a model.
- Rules are developed based on those formal and informal rules that limit the behaviour of actors in every day life.
- The conceptual model is a representation of the environment in which actors behave, the degree of abstraction depends on the objective of the simulation.

Each of these elements is related to each other. Every action is limited by the rules and the effects are represented in the conceptual model. This way the development of all criteria becomes clear for all participants.

The design of STORM corresponds to a large extend with the theory. A difference is that STORM concerns a hypothetical situation, while for support of decision-making a smaller degree of abstraction is required. The design of STORM is limited by the use of computer. It is hard to add new actions at make the consequences of these actions visible. This stresses the importance of research before the design.

# ANNEX 2: Measures that influence the discharge capacity

**Introduction**

The changes in the discharge capacity are the consequence of direct and indirect spatial developments and measures. Indirect developments influence the water supply of the river and therefore the discharge. Examples of such developments are changes in the hardened ground surface that lead to changes in the runoff rates from surfaces. Direct developments concern measures that influence the discharge capacity of rivers and often intervene directly in the cross section of the river. This research will only discuss the developments with a direct influence.

There are a number of developments and measures that direct influence the discharge capacity of a river. Already two were mentioned in the framework of high water protection: the raising of the dikes and the increasing of the retention capacity. There are also developments that influence the discharge capacity that are not directly related to the subject high water protection. These will also be discussed. This leads to the following measures that will be discussed:

- Raising of the dikes.
- Expansion of floodplains
- Construction of retention areas
- Construction of a periodical or permanent side channel
- Lining of the bottom and river banks
- Dredging of the river and lowering the floodplain
- Change length of groins
- Changes in the land-use in the floodplains

***Raising of the dikes***

The oldest and most frequent type of flood protection work is a river embankment, that is construction of dikes on both sides of the river. The dikes give protection against inundation and make high-quality land-use of the former flooded areas possible. A distinction is be made between winter and summer dikes. Winter dikes are designed to protect against the normative discharge. In Germany this concerns the normative discharge with a return period of 200 years. The height of the dike is based on the water level that corresponds with the HQ200 added with the freeboard. The freeboard is an extra raising of the dike that is necessary to prevent the flooding of the area with (during the normative discharge) as a result of surges. Summer dikes are constructed between the winter dikes and the river in order to protect the floodplain against average high water. The placement of summer dikes makes the winter polder available for less permanent forms of land-use during a longer period. The chance of flooding of these areas is dependent on the height of the summer dike. Furthermore, the raising of the summer dike increases the storage capacity of the floodplain.

The raising of the dikes does not influence the discharge or length of a high water peak. Therefore, when a high water peak occurs, possible damage will only be replaced to a downstream area. Furthermore the raising of the dikes creates a vicious circle. Dikes limit the

space occupied by a river and thus its discharge capacity. They also restrict the area over which sediment can be deposited. At a results ground levels in the floodplains have risen by several meters in the last few hundred years. And, as the floodplain heights have risen, so inevitably have high water levels (Middelkoop, 1998).

Another disadvantage of dike raising is that it will finally lead to a larger inundation depth when the dike should collapse and therefore the total amount of damage.

***Expansion of floodplains***

The floodplains are the areas between the main stream (river) and the winter dikes. When there is, besides a winter dike, also a summer dike, the floodplain is divided into a summer polder and winter polder. The water level within the floodplain corresponds with the level in the river. When the floodplain is direct related with the main stream, two main functions are distinguished:

- Carrying a part of the discharge during floods;
- Temporary storage of a part of the total flood volume.

An expansion of the floodplains will increase the discharge capacity of the river and consequently as possible lead to a decrease or delay of high water peaks. When a summer dike additionally protects the floodplain, and the water level rises over the top of the summer dike, the floodplain is able to store water. When the winter polder is filled in the middle of a high water peak, this storage function can lead to a considerable decrease of the water level. However, if the winter polder already filled at the beginning of a high water peak the storage capacity is of considerable less importance. In the high water in 1970 (6079 m3/sec at Worms) all winter polders were filled and the contribution to the decrease of the discharge was negligible. Concerning the case study area the storage capacity of the present ground surface of the floodplains is not of relevance until a discharge between 3900 and 4700 m3.sec. When the discharges are higher than 5500 m3/sec (based on the present situation in this area), the floodplains have no influence on decreasing or delaying the high water peak (Hessen, 1998).

***Construction of retention areas***

A retention area is a storage reservoir, which is created by dams constructed along the river valley. In contrast with the storage capacity in the winter polder, the dams of retention areas are set on the level of the winter dike and the flooding of these areas is controlled by an inlet construction. These areas can be constructed with or without a controlled outlet, that makes it possible to adjust the release of the stored water to the river dynamics. A controlled outlet makes it possible to empty a retention area in a shorter amount of time and therefore less damage to the land-use within the retention area. Furthermore, a controlled outlet makes it also possible decrease the effects of a number of high water peaks that occur in a short amount of time, while a uncontrolled outlet is mainly suitable for areas where high water peaks occur with large intervals.

The inlet construction makes it possible to control the filling of the retention area and therefore a more effective use. While in the previous measure (retention between the summer dike and the winter dike) the use of the storage capacity depended on the water level in the stream, the use of a retention area is only necessary in situation where there is a risk of flooding. When the

water level of the river reaches the maximum level of the winter dikes (this level is related to the HQ200), the inlet is opened. The top of the high water peak is being stored and the capacity of the river is maximum used. After the peak has passed, the stored water is released again.

The total amount of water that would normally pas in ten days with a water level that is higher than the level of the dikes, will be spread over a longer amount of time and with a lower water level. In order to optimise the use of retention areas it is important to have information about the discharges and water levels in upstream areas.

Besides normal retention areas there are also retention areas with an ecological pre-flooding. When a retention area is rarely flooded and the filling takes place in a small amount of time, the ecological system can be damaged. The recovery of these ecological systems can take years or even decades. This can be prevented by keeping the retention area open during medium discharges and, in case of a high water peak, pre-flood the area, the ecosystem has the opportunity to adjust itself to the changing environment. When a retention area is ecological pre-flooded. In this situation the total storage capacity decreases with 20%. This means that, in order to reach the same storage capacity, retention areas with an ecological pre-flood need 25% more ground surface that retention areas without this ecological pre-flood (Hessen, 1998).

For retention areas with an ecological pre-flood a controlled outlet can be more suitable, because some forms of vegetation can endure anaerobe circumstances only for a short amount of time.

***Construction of a periodical or permanent side channel***

A side channel is connected to the main stream and increases the maximum discharge of the section in which the channel is constructed. This measure mainly affects the area where the measures are taken and are therefore mainly suited in areas where the discharge capacity of the main river is much smaller than the top discharge and expansion of the river capacity is difficult. An example is a section of river that runs through the centre of a town. The construction of side channels can also be of importance in situation high water peaks in the main river and in tributaries occur in the same time. In this matter a side channel can split both high water peaks, by delaying one of them. However, in situations where the water has a high velocity, such as the Rhine, these side channels require an enormous length. Therefore, this will be a very expensive measure.

A temporary diversion channel will be put into operation during a dangerous high water peak, by opening the gates. When the diversion channel is not used to increase the discharge, it will serve as the main drainage canal for the floodplain. Furthermore, it can have an ecological function. The operation of temporary side channels can take place with locks. Also more natural barriers can be constructed that prevent the water from flooding into the side channels in times of medium discharges.

***Lining of the bottom and river banks***

Reducing the roughness of the riverbed (lining the bottom) and the riverbanks can increase the velocity of the water and therefore the discharge capacity of the river. Lining of the bottom is

however a very expensive measure with small effects, compared to some other measures discussed in this section. The roughness of a riverbank can also be reduced by removing bushes, trees, hedges and other obstacles. Because the vegetation is necessary to protect the riverbanks from degradation, other materials should be placed that suppress the removal of the deposited material by bank erosion processes, for instance stone riverbanks. In wide rivers, the roughness of riverbanks has only a small influence (ca until 5 meters of the riverbank).

***Dredging of the river and lowering the floodplain***

Deepening and widening the main channel (dredging) or lowering the floodplain (assuming that the water level in the floodplain will be the same as in the flood) can increase the discharge capacity of a river. Lowering the floodplain also causes an increase in the groundwater level. Deepening of the main channel is only effective if the bed load transport is small, otherwise the deepened area will be filled with sediment in a short amount of time. A side effect of deepening the main channel is that the ground water level can decrease n increased discharge capacity can cause shortages of groundwater in certain times, because the water level in the river is related to that of the floodplain. However, concerning the Rhine these effects are marginal and therefore will be left out of consideration.

***Change length of groins***

The changing of the length of groins keeps a smaller part of the river deep and therefore navigable in times of low water. However, groins can be seen as a roughness in the bottom and therefore decrease the velocity of the water. Because the river has the largest velocity in the centre and a smaller velocity in at the sides, these measures also decrease the process of degradation of riverbanks. Changing the length of groins however, is only relevant in areas where the river is wide and undeep. In the case study area the Rhine does not contain groins and there is no need to construct them. This measure will therefore be left out of consideration.

***Change the land-use in the floodplains***

Changes in the land-use in the floodplains can decrease the retention capacity and discharge capacity of the river. Mainly the expansion of industrial ground surface can lead to a decrease. The effect of changing agriculture into nature areas is marginal.

# ANNEX 3: The process of decision-making

**Introduction**

Selecting the right participants in decision-making processes does not lead automatically to a good solution. Also during the process of translating individual objectives into a common objective, a large number of mistakes can be made that can influence the result. In order to formulate a number of specific recommendations for the process, this section discusses how these processes are constructed. Starting point for this discussion is policy analysis.

Policy analysis is focused on the behaviour of large organisations and particularly on how they might improve their ability to make rational decisions. Within policy analysis an ideal decision-model has been formulated that distinguished seven stages in decision making: formulation of goals and objectives, identification of alternatives, prediction of consequences, evaluation of consequences, decision based on information provided in the preceding steps, implementation of the decision and feedback (Friedmann, 1987).

How these stages succeed depends on the form of decision-making. Voogd (1995) distinguished three forms of decision-making. First the linear form of decision-making, that is constructed out of different phases and there is no possibility to return to earlier phases. The second form is a linear process with the possibility to return to earlier phases. In this process one has the possibility to return to the previous phase. The third form that is distinguished is the dynamical or cyclic decision-making process. In this process it is possible to return to multiple earlier phases.

The need for returning to earlier phases arises from the need for effectiveness and the prevention of uncertainties. When there are no possibilities to return to earlier phases, all the time a complete analysis of the phase has to be made. This causes a great need of information that turns out to be useless in a later stage of the process. The opposite is that a group makes decisions based on limited information and it turns out that they need further information about an earlier phase. In this situation the prohibition to return to earlier phases causes decisions that are made in uncertainty. This can damage the commitment during the implementation, when it turns out that a decision has consequences that were not foreseen.

**Phase 1: Signalling problems**

Signalling or introducing a problem is a condition for policy development. Problems are often signalled by an individual or a small group of actor. Some actors have the power to put this on the public agenda themselves. Actors that do not posses this kind of power have to convince others (that are able to set the public agenda) of the need for a solution.

*Public agenda setting*

The concept of agenda setting deals with the question why the government decides to develop policy for certain issues and ignores other issues, and what the role of stakeholders in this matter is. Kingdon (1995) derives the public agenda setting process from three aspects: problems, politics and visible participants.

If a situation becomes a problem depends on two aspects: the means by which officials learn about conditions and the way that conditions are defined as problems. As to means, three forms are distinguished: indicators, focusing events and feedback. Indicators are used to assess the magnitude of the condition (e.g. the number of accidents on highways). Second, a focusing event, a disaster, crisis, personal experience, draws attention to some conditions more that others. Third, officials learn about conditions through feedback about the operation of existing programs, either formal (e.g. monitoring) or informal (e.g. complaints and media).

People define conditions as problems in several ways. First, conditions that violate important values are transformed into problems. Second, conditions become problems by comparison with other countries or other relevant units. Third, classifying a condition into one category rather than another may define it as one kind of problem or another. The lack of public transportation for handicapped people, for instance, can be classified as a transportation problem or a civil rights problem, and the treatment of the subject is dramatically affected by the category.

Politics consist out of two elements: national mood and elections. National mood refers to the colour of a government. A more conservative government dampens attention to costly new initiatives, while a more tolerant national mood would allow for greater spending. The second element, elections, relates to developments in the political sphere. When new elections are coming up, political parties often place issues on the agenda in order to gain votes.

Visible participants are those actors that receive considerable press and public attention. On the opposite sight is a cluster of relative hidden actors. This cluster includes academic specialists, career bureaucrats and congressional staffers.

Not only those actors that receive attention by the media, but also the media itself is an important agenda-setter. The media pays attention to social and politic problems that policy makers would rather not see on the agenda, especially issues that concern unethical or negligent behaviour. Maybe the most famous example in this matter it the Watergate scandal, in which two reporters of the Washington Post revealed the illegal activities of the government of president Nixon (Rosenthal a.o., 1996).

That not only visible participants but also hidden-participants can influence the agenda setting process is illustrated by the concept bell-ringer. A bell-ringer is a(n) (ex-)member of an organisation that reveals information without approval from superiors, with the intention to focus the attention on a wrong situation of which he has become aware by his work within the organisation (Rosenthal a.o., 1996).

*Public agenda and public acceptance*

When a policy problem is placed on the public agenda, it is often recognised by one or a small number of governmental or private organisations. This however does not mean that other parties accept the problem. The way a problem is set on the agenda will also determine the way this problem will be accepted. Problems placed on the agenda by focussing events (triggers) will make public acceptance more easily. This can become a problem if the government is, in

order to solve the problem, dependent on other actors that do not accept the problem. In general, two causes of non-acceptance can be distinguished:

- Parties are not well informed about the status quo of conditions or about the effect that these conditions have. Acceptance in this matter can be created by informing parties (Kuipers & van Woerkum, 1995).
- Different organisations have different values. Values are normative and are based on the estimation of risks and on the risks that are accepted by a party (WRR in: Hidding, 1997). An example of this is the maximum concentration of chemicals in the air. The government has set a certain value. Once this value has been exceeded, the government defines this as a problem situation. Other parties may have different values and will not accept it as a problem. In this example the government has a strong position because other parties can be legislative enforced to co-operate. In other situation, for instance the development of new policies, it can not always be that easy. In this case there is a bigger problem with acceptance. A fundamental discussion has to be started in which values have to be accepted.

**Phase 2: Problem structuring**

In order to discuss the process of problem structuring, first the concept of policy problems need some elaboration. Policy problems are unrealised values, needs or opportunities which, however identified, may be attained through public action. In the process of structuring the problem is being translated from an abstract description into a more concrete description.

One of the problems in structuring problems within groups is that all participants can agree on the existence of a problem but interpret this problem in different ways. In this matter three different factors can be distinguished.

1. Actors define the problem in a different way. For instance, one person may define crime solely in terms of illegal acts against persons (homicide, armed, robbery, rape) while another may focus on illegal acts involving property (theft, fraud).
2. Actors may disagree about the class of problem. This has already been discussed in the process of agenda setting. The class in which a problem is defined will affect the alternatives that are developed. When crime is seen as an economic problem the potential resolution lies in restructuring the production and distribution of goods and services in society. When crime is seen as an administrative problem one will search for solutions in strictly enforcing existing criminal legislation.
3. Third, actors may agree on the definition, classification and explanation of a problem yet disagree about its scope, severity and importance of this problem (Ackoff, 1974).

When actors decide to solve a problem together a common problem definition is required. The participation of actors is essential in the identification of problems, but the problem analysis will also help to identify all possible actors. The problem definition concerns not only the definition of a common problem but also of the relating causes and their weight (in what size do they influence the problem). There are a number of techniques that can be used in this matter dependent on the nature of the problem. Examples are problem-trees, cause-effect tables and WWWWW-questions (Heun & Koudstaal, 1999).

Because policy problems often contain a large number of causes boundaries have to be formulated in order to define what is part of the causes that have to be solved and what is not. Important bases for setting boundaries are the activities that cause a problem and their weights. When a cause of relative small importance can not be influenced by the present actors, this can be a basis for excluding it. However, when the present participants can not influence an important cause, new participants should be added. In this matter also relations between causes are of importance. Not only activities but also natural and juridical (administrative) borders are of influence. Examples are water systems and national authorities. Furthermore, also conditions about the other characteristics have to be taken into account. They include, among other things, the time horizon taken into account and the hydrologic and meteorological conditions.

Based on the problem definition, a number of objectives can be formulated. One of the fundamental premises underlying the analysis for resources management is that the analysis will be quantitative where possible (Heun & Koudstaal, 1999), in order to compare them in a later phase. This means that also the objectives have to be formulated quantitatively. The following step is translating objectives in (quantitative) criteria. Criteria are functions indicating a direction of increasing or decreasing preference and are expressed in indicators. Each criterion is given a weight in order to define the its importance for reaching the objective (Walker, 1988).

One of the difficulties is coming to a common set of criteria and weights that is equally valued by all participants. Participants can have hidden agenda or will not accept all criteria. This will show in a later phase of the process, when the participants prefer another alternative than the one based on the criteria.

Concerning the subject problem structuring, two final remarks have to be made. First of all, the problem definition and setting of objectives influences the agenda of the process. By conceptualising the problem within a certain class, causes of problems or related actors can be excluded from the interest. This can be the consequence on (a) a lack of knowledge by the participants or (b) a strategically action of one of the participants (Berkers a.o., 1996). Second, all participant have to be committed to the objective or methods used (Aarts, 1998). This means that when actors are present that are needed because of the resources that they have to their disposal, the objective of the process has to be formulated that way that all needs are represented.

**Phase 3 & 4: Developing alternatives and comparing alternatives**

The developing of alternatives does not always take place as a formal process. Actors often propose possible alternatives during the problem-structuring phase. In other situations a specific alternative is the motive for a decision-making process. When there are no alternatives developed, the involved actors have to develop them themselves. Walker (1988) defines two methods for this: search and creativity. Search suggests that the solution to the problem is available and needs only to be identified by discovering and perhaps recombining its pre-existing constituent parts. Creativity is the capability to view a problem and propose alternatives in perspectives and methods that are unique and unlike prior attempts to solve similar

problems. There are a number of techniques for developing creative alternatives, of which brainstorming is one.

Alternatives are constructed out of two elements: tactics (these are actions) and strategies. A tactic is a single thing to do to meet an objective. For example, in developing a water management policy, the tactics might include building particular waterways, imposing charges on particular discharges and issuing permits for particular uses. A strategy is a combination of tactics: it describes on possible set of actions to meet an objective (Walker, 1988).

**Decision making models**

In this figure five models of decision-making are discussed: the rational model, the optional model, the incremental model, the mixed-scanning model and the satisfycing model. Although these models do not represent all decision-making models, they give a broad outline on the way decisions are made.

**The rational model**

The theory of rational decision-making assumes that a decision-maker is able to identify all alternatives and their consequences in order to solve a certain problem. By comparing all alternatives, decision-makers can identify the most preferred decision (Muller, 1997). Criticisms on this approach focus on the disparity between the requirements of the model and the capacities of decision-makers. Social decision-making centres frequently do not have a specific agreed upon set of values that could provide the criteria for evaluating alternatives. In addition, information about consequences is, at best, fractional. Decision-makers have neither the assets nor the time to collect information required for rational choice. Finally, rather than being confronted with a limited universe of relevant consequences, decision-makers face an open system of variables, a world in which all consequences cannot be surveyed (Etzioni, 1967).

**The optimum model**

In the optimum model decision-makers do not strive for the best decision, but for the decision with the largest positive effect for the decision-maker(s). In this process not only rational arguments are used, but also non-rational aspects, for instance intuition and experience. The optimum-model represents are more realistic view on decision-making than the rational model. However, the main disadvantage is the same as in the rational model, that it is not efficient to evaluate all alternatives.

**Incremental model**

Incrementalism seeks to adapt decision-making strategies to the limited cognitive capacities of decision-makers. Instead of evaluating all alternatives, decision-makers only focus on those policies, which differ incrementally from existing policies. Also the number of policy alternatives are considered is smaller than in rational processes. The weighing of alternatives is based on a restricted number of important consequences. The result is not the best solution, but more a correction of the status quo.

The incremental strategy does not apply for situations that are in need of one large or fundamental decision. Another criticism on this approach is that the model assumes that the existing situation is good but need little adjusting. Sometimes radical change is needed in order to find a solution for the problem. Furthermore, small steps do not imply that they can easily be made undone (Muller, Etzioni).

**Mixed-scanning model**

The mixed-scanning model is a combination of the incremental model and the rational model. Within the model decision-makers combine a detailed examination of some alternatives with a global review of others. During the global scan information is gathered to gain insights. Based on these insights the number of possible alternatives is reduced. This choice also points out what information is further needed. By repeating these steps a decision can be made in a relative short time (Etzioni, Muller, van Woerkum). The criticism on this model is that it is assumed that the alternatives can be compared.

**Satisfycing**

The theory of satisfycing relates to the concept “bounded rationality”: constraints in capacity of persons to process information. Within this model a decision-maker chooses a number of alternatives based on experience. Then, decision-makers decide what his goal is in the decision-making process. The first alternative that reaches the objective will be chosen.

The strength of this model is that it acknowledges the different values of group members. Instead of aiming at the best decision, the objective is to take a satisfying decision. This way compromises can be made. A criticism on this model is that it can damage the quality of the final decision: important decisions can be ignored of be sacrificed in order to come to a compromise (Muller, Walker, 1988).

The criteria that have been developed during the problem structuring are the bases for the comparing of alternatives. Processes of comparing alternatives can take place in different ways. In the above figure a number of theoretical approaches of comparing alternatives have been described. When these models are compared with the characteristics of ill-structured problems, a number of conclusions can be drawn.

- In ill-structured problems and analysis of all alternatives can be a very time and money consuming process. In these situations it is better to analyse a broad number of alternatives on a global scale and a selected number on a more specific scale.
- In the process of choosing which alternatives have to be analysed, not only those alternatives that differ slightly from the current situation should be selected, because this could prevent a structural solution of a problem.
- The identifying of the best possible course of action is limited by normal constraints on rationality, which include resources, information and the time that is available for making decisions.
- In situations with a large number of decision-makers it is hard to aim for the optimal alternative, because, based on their values, all actors have a different formulation on the best alternatives. This makes it hard to come to a common set of general accepted set of criteria's, that is equally valued by all participants, on which the decision is made It could be better to aim at the first acceptable alternative.
- Within the process the incompleteness of information makes it hard to make an objective analysis of the consequences of different alternatives. Knowledge based on experience can help in this matter to deal with uncertainties.

Furthermore, there is also a constraint on the number of alternatives that can be taken into account. The maximum, bases on the rational constraints, is seven alternatives. Furthermore, a number of variations can be defined.

**Phase 5: Pointing out of uncertainties**

Based on the limited amount of information, it is hard to eliminate all uncertainties. The effectiveness is often are influenced by other systems that can not be controlled. In this matter it is of course not attractive to choose for the best alternative when this has a large number of uncertainties.

**Phase 6: Making a decision**

When all steps have been taken in the right way, it should be easy to make a decision. However, in this phase it can become clear that not all participants agree with the solution that is, based on phase four and five, the best alternative. This can be caused by an insufficient problem structuring phase or hidden agendas of participants. When this is the case, one has to return to earlier phases as described at the beginning of this section.