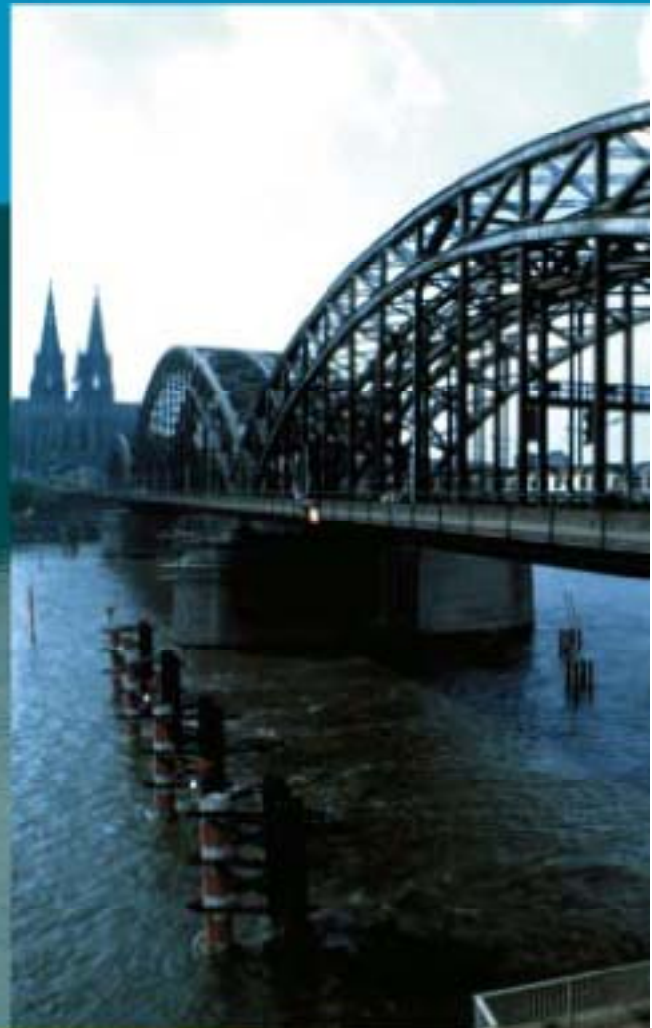
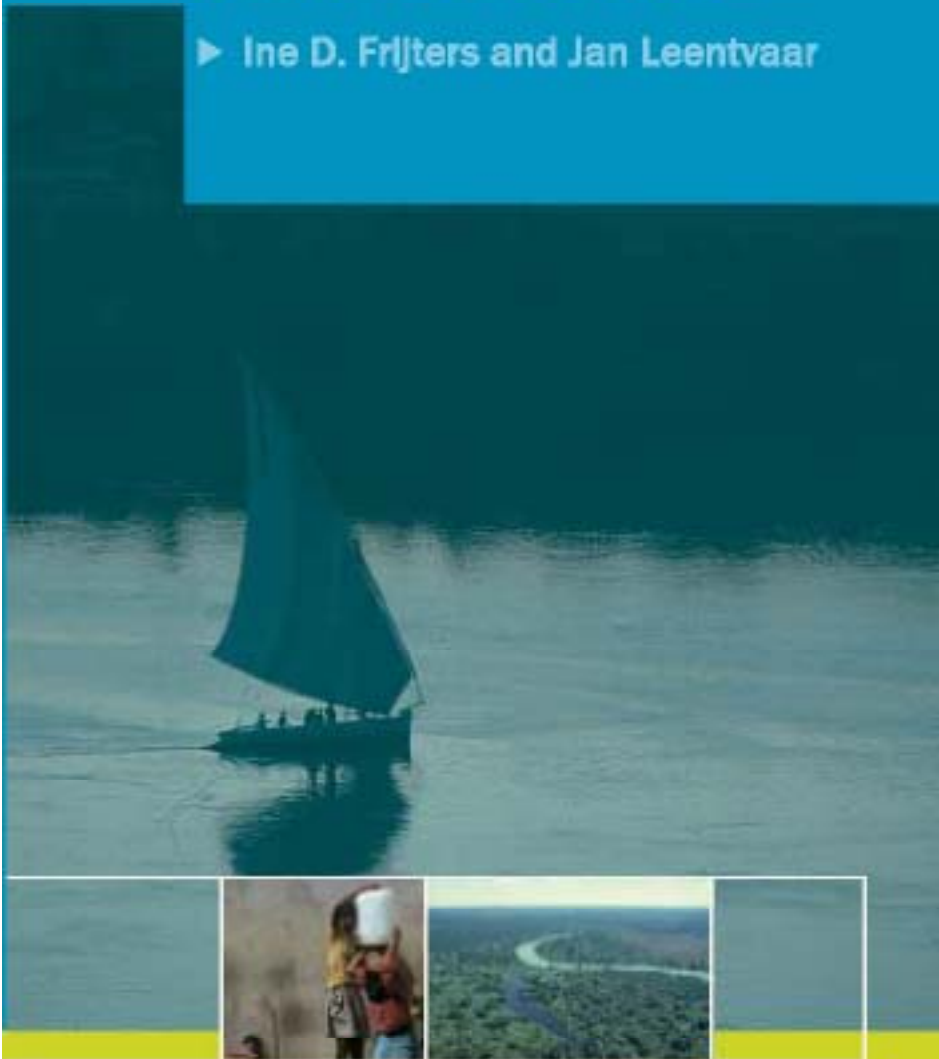


Rhine Case Study

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RHINE CASE STUDY

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SUMMARY

Experience with conflicts and cooperation in the Rhine basin proves the usefulness of river basin organizations.

The major Rhine basin organizations deal with only one specific aspect of the river. The most important organizations are described, with their legal background, their tasks and duties, and their development.

The theoretical aspects of conflict prevention and resolution are illustrated with water-related conflicts along the river Rhine. These cases deal with flooding, navigation, fisheries, water pollution, salt discharge, and accidental spills.

Special emphasis is placed on the possibilities and implementation of public participation in water management.

The lessons learned indicate, that a sound technical scientific cooperation strongly supports the basis for transboundary water management policy.

1. INTRODUCTION

Although the Rhine is a relatively small river, it is one of Europe's best-known and most important rivers. Its length is 1,320 km, of which 880 km is navigable. From its source in Switzerland, the Rhine flows via France, Germany, and the Netherlands into the North Sea. The catchment area of 170,000 km² also covers parts of Italy, Austria, Liechtenstein, Luxembourg, and Belgium (Figure 1).



Figure 1. Characteristics of the Rhine

Figure 1. Characteristics of the Rhine

2. THE RHINE RIVER BASIN AND ITS GENERAL SITUATION

2.1. Physical-Geographical Situation

The Rhine river basin can be considered as representing four distinct river ecosystems. The High Rhine, upstream of Basel and located mainly in Switzerland, includes two important reaches of ecological importance, particularly with respect to the protection of reserves of international importance for fish and migratory birds. The river has a channel slope varying between 1/200 and 1/1,000. At present, considerable conflict exists between ecological concerns on the one hand, and increased use (above all in hydropower development) on the other.

The Upper Rhine reach is located between Basel and Bingen. Flood mitigation measures were initiated in the 1860s together with inland navigation. From 1930 onwards, several major hydraulic works were constructed, including eight dams for hydropower, two storage dams, and dikes. Except for the upper part from Basel to Iffezheim, having a slope of 1/1,000, most of the portions have a channel slope varying from 1/200 to 1/50. This reach is the most important reach for the rehabilitation and protection of the alluvial areas along the Rhine. The alluvial areas of

the Rhine comprise alluvial forests, wooded fringes near water bodies, reed plains with many stagnant pools, and water-filled swamps. They form complex habitats for many species of flora and fauna, which are difficult to restore once they are lost. This is why efforts are made to preserve the alluvial forests and meadows and to extend these areas to the recently created habitats. In France, ecological improvement action is planned for the mainstream and its flood plains, some tributaries, the old riverbed of the Rhine, the Rhine canal, and the drainage canals. Habitats for some endangered or extinct species, such as otter and beaver, will be restored in these reaches.

The Middle Rhine is located between Bingen and Cologne. Its landscape, with the river, alluvial areas, and steep slope, is unique in the whole of Central Europe. The fifteen islands in the Rhine are among the areas of particular ecological importance. Alluvial forests or their remnants have survived only on those islands, which have already been placed under protection. Narrow strips of such forests exist in some bays in the valley. This is also a short section of the river with an average slope of 1/100.

The Lower Rhine consists of the lower river reach between Cologne and the German–Dutch border and the branches of the delta in the Netherlands. The lower river reach covers major cities and industries, for which major flood control works were constructed around 1900. The river slope varies from 1/20 in the upper part, to 1/200 in the middle part and to 1/500 near the German–Dutch border. In the Netherlands, the average channel slope is about 1/1,250. The delta is a major flood-prone area with a potential flood damage of €1,100 billion, when the river discharge exceeds the channel capacity of 15,000 m³/s.

Since the Rhine has become a navigable waterway and flood control measures have been taken, such as the construction of dikes along the Upper and Lower Rhine, large stretches of floodplains have been lost. Along the Upper Rhine, the loss of alluvial areas has reached dangerous proportions. Between 1955 and 1977, more than half of the former flooding zones along the Upper Rhine were protected against inundation and are now inhabited and used for farming. Consequently, the habitats of animal and plant species depending on the alluvial areas have been reduced drastically. These radical measures increased the sensitivity of the Rhine ecosystem to disturbances. It is why the Ecological Master Plan, known as the "Salmon 2000" Action Program, which started in 1991, requires an extension of the alluvial areas along the Rhine.

2.1.1. Functions

There are significant differences in the spatial variation in the functions of the Rhine catchment area (see Table 1 for the states along the main flow of the Rhine). The Rhine is Europe's most densely navigated shipping route, connecting the world's largest seaport, Rotterdam, with the world largest inland port, Duisburg. Vast industrial complexes are built along the river, for example the Ruhr, Main, and Rijnmond areas. Most of Europe's important chemical production plants can be found along the Rhine.

Rhine water is used for industrial and agricultural purposes, for energy generation, for the disposal of municipal wastewater, for recreational activities, and for the production of drinking water for more than 20 million people. Furthermore, the Rhine is a natural habitat for a diversity of plant life and many birds, fish, and other species.

Obviously, so many different claims on the river inevitably lead to conflicts or problems: water quality problems, problems in river ecology, and high water problems.

2.2. Historical, Political, and Economic Characteristics of the Basin

The Rhine riparian states have a common historical background. Throughout history parts of the Rhine river have functioned as the border between states. The Rhine regions are connected through several conflicts, part as aggressor and part as conquered region. Some Rhine regions were hard-hit by violent conflict, especially in Alsace-Lorraine and the Netherlands.

	<i>Switzerland</i>	<i>France</i>	<i>Germany</i>	<i>Netherlands</i>
Drinking water			X	X
Process water	X	X	X	X
Irrigation				X
Hydropower	X	X		(X)
Amenity	X		X	X
Fishing water				X
Navigation	X	X	X	X
Sewage	X	X	X	X

Table 1. Spatial variations in the functions of the Rhine catchment area

Source: After Dieperink, 1997.

2.2.1. History

Historically, the development of the states has been unique but along the same lines. There are differences in culture and relations but the major values are comparable. The Rhine itself was hardly the object of violent clashes, although the river was of importance to ensure a safe border against aggressive neighboring states and as a major shipping route.

The largest fairly recent border change in connection with water is the moving border between France and Germany, which will be explained in more detail later in this article.

All states are democracies and have developed to a similar level economically (Table 2) and technically.

	Inhabitants	GNP	Per capita in \$	Language
Austria	8.1 M	191 B	25,220	German
Belgium	10.3 M	231 B	24,630	French/German
France	58.9 M	1.3 T	23,670	French
Germany	82.0 M	1.9 T	25,050	German
Italy	57.7 M	1.1 T	20,010	Italian
Liechtenstein	32,000			German
Luxembourg	438,000	18.6 B	44,340	French/German
Netherlands	16.0 M	364.9 B	25,140	Dutch
Switzerland	7.2 M	240.3 B	38,120	French/German

Table 2: Rhine states

Note: B = billion, T= Trillion

Source: Data from World Bank, 2000.

As seen from Table 2, there is considerable similarity in development between the countries. One difference is that, with the exception of Switzerland, all states are member states of the European Union. This means that European Law and regulations bind all but one country.

2.2.2. Cooperation

To explain the processes of cooperation, negotiation, and mediation from a historical perspective is no easy task in this region. There are many examples of cooperation between states or regions; in historical times alliances between states to oppose an aggressive third party were preferred.

In historical times, negotiation was widely used all over Europe. Much of this was because of the existing royal families and their policies that, for the most part, dealt with exchanging land for dynastic purposes through marriage or giving land in order to appease a neighboring aggressor state.

When negotiation did not bring the preferred outcome, a third monarch sometimes was asked to mediate.

3. RIVER BASIN ORGANIZATIONS

3.1. Rhine River Basin Organizations

Of the different organizations related to the Rhine basin, three are described in more detail.

3.1.1. Central Commission for Navigation on the Rhine (CCNR)

The Central Commission for Navigation on the Rhine dates back to the final act of the 1815 Congress of Vienna. Today, it is based on the so-called Mannheim Act (revised Rhine Navigation Act) of 1868, in its 1963 version. The Central Commission for Navigation on the Rhine is the oldest European organization that is still active. For Rhine navigation in the nineteenth century, it made the idea of European integration a reality. The main tasks of the Central Commission are to ensure the freedom of navigation on the Rhine and its tributaries, and to maintain a uniform legal regime governing navigation along the full length of the river.

The Netherlands, Belgium, Germany, France, and Switzerland are member states of the Central Commission for Navigation on the Rhine. The delegation of each member state is composed of four representatives (Commissioners) and two substitutes (Deputy Commissioners). Committee resolutions must be made unanimously. Thus, each member state has a right of veto. By rotation, each member state chairs the committee for a period of two years.

The Commission passes resolutions unanimously in line with its terms of reference as follows:

- proposals concerning the prosperity of navigation on the Rhine
- adoption of technical and administrative regulations (and their amendments) concerning the safety of vessels
- complaints arising from the application of the Mannheim Convention.

3.1.1.1. Organization

The organization has its headquarters in Strasbourg, in the "Palais du Rhin." The commissioners assemble twice a year (in spring and autumn/fall) to hold a general assembly of the CCNR. The sessions are chaired by the president of the Commission. In addition, some fifty further meetings are held by ten sub-committees and their working groups to deal with legal, economic, and technical matters. The permanent secretariat employs about fifteen staff, and the organization's annual budget amounts to €1.6 million. The five member states make equal contributions to the budget.

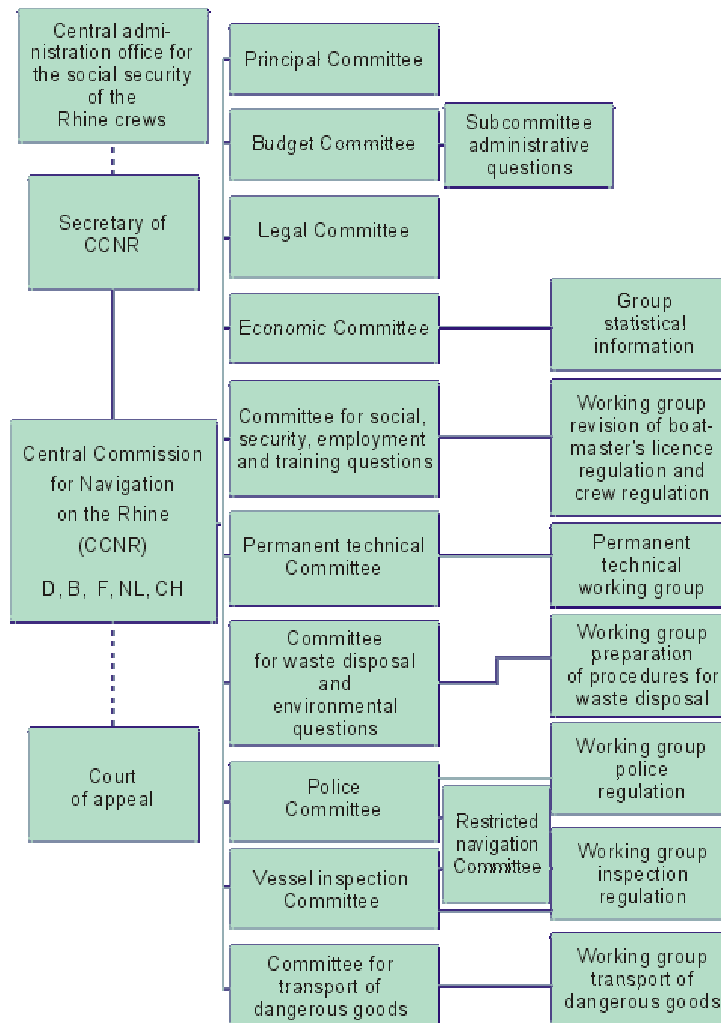


Figure 2. Organization of the CCNR

3.1.2. International Commission for the Hydrology of the Rhine Basin (CHR)

The International Commission for the Hydrology of the Rhine Basin is an organization in which the scientific institutes of the Rhine riparian states develop joint hydrological measures for sustainable development of the Rhine basin.

The CHR was founded in 1970, following advice by UNESCO, to promote closer cooperation in international river basins. Since 1975, the work has been continued within the framework of the International Hydrological Programme (IHP) of UNESCO and the Operational Hydrological Programme (OHP) of WMO. The member states of the CHR are Switzerland, Austria, Germany, France, Luxembourg, and the Netherlands.

The CHR focuses on:

- Expansion of the knowledge of the hydrology in the Rhine basin through joint research, exchange of data, methods, and information, and development of standardized procedures and publications in the CHR series.
- Making a contribution to the solution of cross-border problems through the formulation, management, and provision of:
 - information systems, for instance, GIS for hydrological practice
 - models, for instance, models for water management and a Rhine Alarm model.

As a working alliance of the states riparian to the Rhine, the CHR is able to combine complex data records into a uniform database, and projects can therefore be

conducted which relate not just to the river line itself but also to the entire Rhine basin. The themes of these projects are:

- hydrological interests in water economy and flood control
- sediment management
- hydrological forecasts and models
- comparison between methods and measuring equipment
- research into climatic changes and their possible effects
- registration of the interactive relationships between the various influencing factors on the hydrology of the Rhine basin.

The CHR deploys working groups and reporters to carry out these projects. The hydrological services and universities of the individual member states second specialist staff and make resources available. Where necessary, the CHR liaises with other international organizations and/or makes its findings available to them.

3.1.2.1. Organization

The CHR is a permanent, autonomous, international commission that undertakes its activities throughout the entire Rhine basin. It is incorporated as a foundation in the Netherlands. The CHR comprises permanent representatives of the member states (coordinators) and a secretariat. The permanent representatives are responsible for involving national public and private sector research organizations that play a significant role in water management.

The presidency rotates among the member states. The president supports the work of the CHR, sets new incentives, represents the commission in public, and chairs commission meetings. The office of the secretariat is located at RIZA (Institute for Inland Water Management and Waste Water Treatment) in the Netherlands. The secretary supports the president's activities and supports the working groups and reporters. The CHR meets twice a year. The commission:

- defines the strategy and program of activities of the CHR
- creates and safeguards good relations with scientific and hydrological services in the Rhine riparian states and the EU, as well as with international organizations
- takes decisions on projects to pursue and on the publication of completed projects.

The CHR coordinates its activities with other international organizations, most notably those in the Rhine basin. The secretary of the ICPR (International Commission for the Protection of the Rhine) attends the CHR meetings. CHR members take part in ICPR working groups.

3.1.3. International Commission for the Protection of the Rhine (ICPR)

The Federal Republic of Germany, France, Luxembourg, the Netherlands, and Switzerland created the International Commission for the Protection of the Rhine against Pollution in 1950. The exchange of diplomatic notes at the end of the 1940s was the base for the transboundary cooperation. However, this base proved to be insufficient for good professional cooperation. The diplomatic notes did not contain agreements about the presidency, the cost of investigations, publication, and so on. The ICPR finally received its legal foundation with the conclusion of the Convention of Berne in 1963.

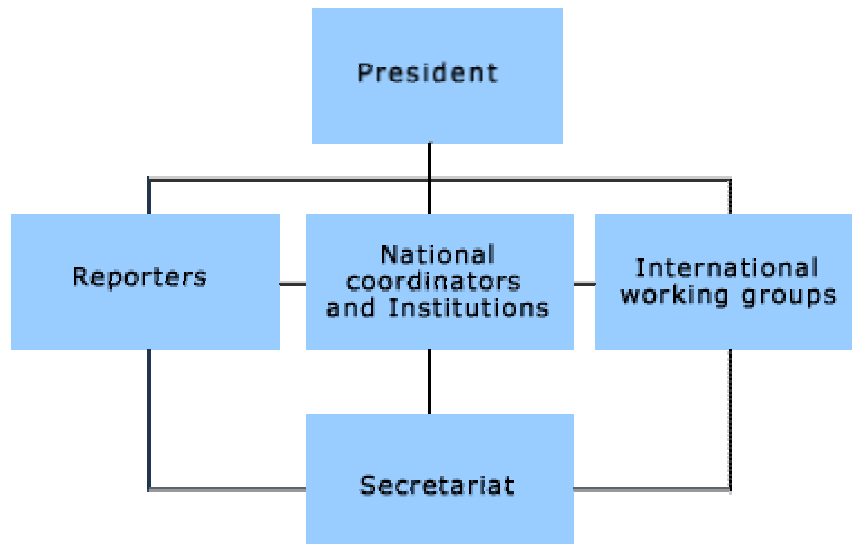


Figure 3. Organization of the CHR

The ICPR has to cooperate with the Central Commission for Navigation on the Rhine and the international commissions that protect Lake Constance and the transboundary tributaries Moselle and Sarre against pollution. Article 2 of the Convention defines the mission of the ICPR. The ICPR has to formulate investigations into the type, source, and extent of Rhine pollution, recommend appropriate measures to reduce it, and prepare agreements between the participating countries. In addition, the ICPR is required to be competent in all matters with which the Rhine states jointly charge it. This last regulation proved to be very useful. The Rhine states could charge the ICPR with the rehabilitation of the Rhine ecosystem in 1987 and dealing with the flood problems in 1995.

The actual implementation and funding of measurements and measures are the responsibilities of the individual basin states. That means that the ICPR is only a negotiation platform and an adviser to the Rhine governments and, since 1976, the European Union.

As the tasks of the ICPR increased over the years, the eleventh Rhine minister's conference of December 1994 charged the ICPR to update the Convention of Berne. The new convention had to consider the regulations of the UNECE-Helsinki agreement of March 17 1992 and important parts of the future Water Framework Directive of the European Union, and integrate the existing conventions and programs. Legal frameworks particularly help in difficult situations during negotiations within the ICPR. They contain regulations for transboundary cooperation. Legal frameworks provide a common grip to find the way out. At present the legal basis for the work of the Commission is the new "Rhine Convention," which was signed in April 1999 in Berne. To illustrate the broadening of the mandate of the ICPR, the words "against pollution" were dropped from its name. Its new name is "International Commission for the Protection of the Rhine."

3.1.3.1. Organization

Ministerial conferences are held every two to three years to formulate the political goals of the Commission, and are at the same time the platform for assessment and evaluation of activities carried out. The Commission itself, consisting of the highest officials from the different member states, meets annually in the Plenary Assembly and decides on working programs, finances, and formal procedures. A coordination group meeting four times a year is responsible for the actual planning and

coordination of the work of the ICPR. Three permanent working groups cover the areas of water quality, ecology, and emissions. Two project groups deal with the Action Program on Flood Defence and the preparation of a new program for the sustainable development of the Rhine. The project group on the new convention has completed its work. The project group on flood defense was recently transformed into a permanent working group. Expert groups deal with specific problem areas related to the work of the working and project groups. All groups consist of government experts from the ICPR member states. Every three years, the presidency passes to another contracting party. The work of the Commission is supported by a small international secretariat with a permanent base in Koblenz, Germany.

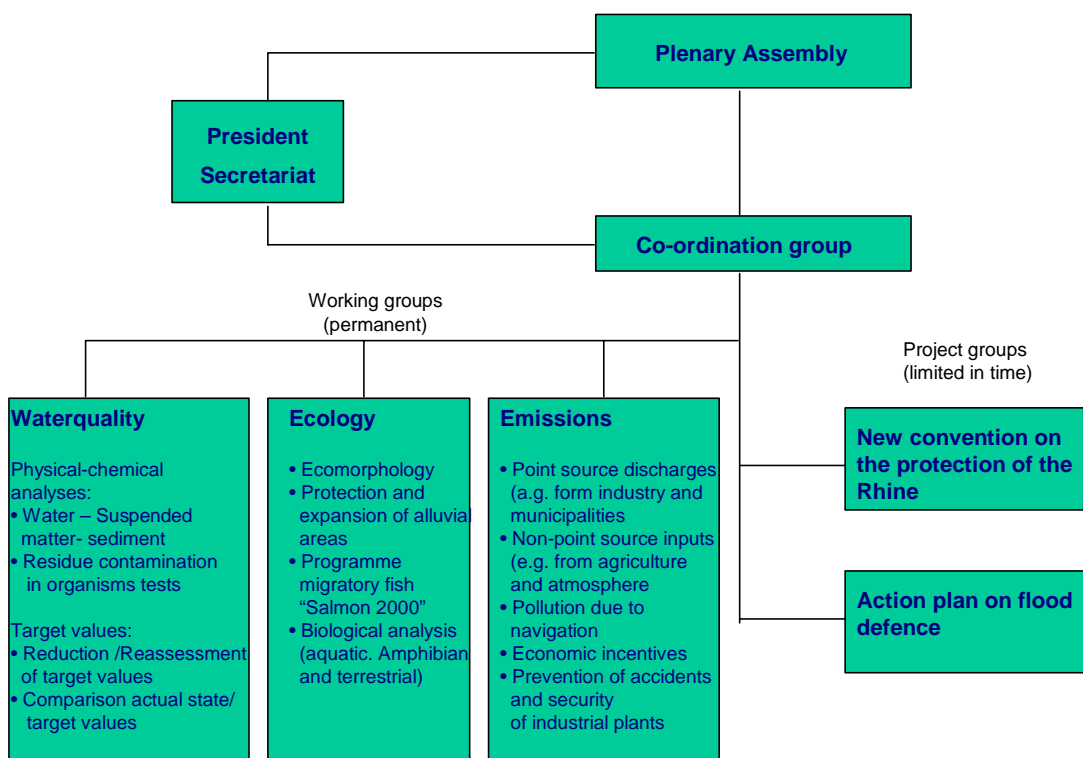


Figure 4. Organization of the ICPR

4. THEORETICAL BASIS FOR CONFLICT PREVENTION

4.1. Conflict Prevention and Resolution

Different types of conflict exist, for example: inner state, interstate, bilateral and multilateral, armed and non-armed. All conflicts develop in phases and may evolve from one stage to another.

4.1.1. Phases in Conflict

Conflicts do not (with few exceptions) come into existence all at once. It takes time for them to grow, as it were. The phases in an interaction are as shown in Figure 5.

During this process there may be opportunities for the states involved to stop the process and try to find a solution for the problem. This solution of course differs with the participants, but also with the phase of the conflict. These processes are at work in all transboundary river basins, whether they are managed in the phase of cooperation or conflict.

Causes of conflicts are diverse in nature. They are likely to arise when a transboundary river basin is not managed according to the interests of riparian states. They may stem from pollution by an upper riparian state, scarcity of water, and/or unequal distribution of the available water. A conflict may also arise if an upper riparian state uses its power to regulate the flow of water to the lower countries, thereby using water as a political means.

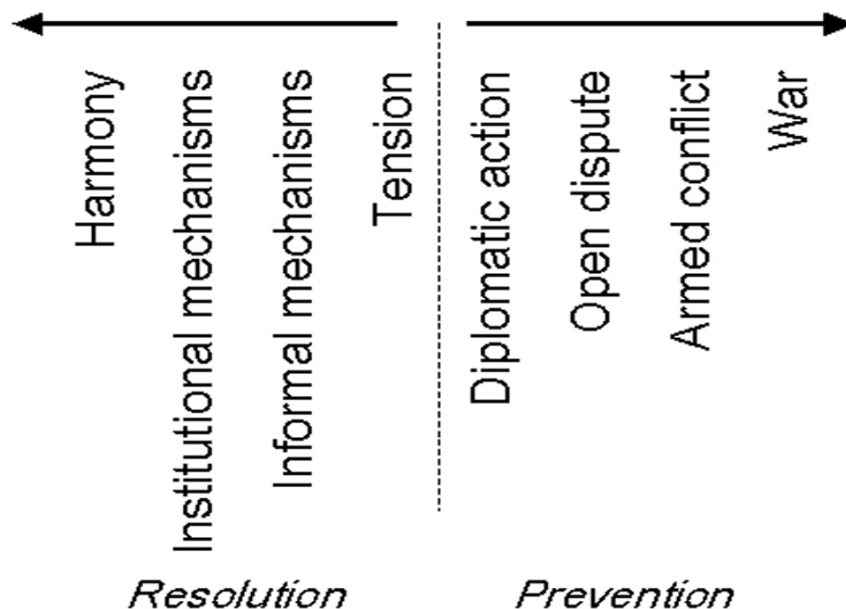


Figure 5. Interaction between states and/or individuals

Source: Greencross, 1997.

On the other hand, conflicts may arise out of cultural differences such as different attitudes towards water as a holy source.

Conflicts may also stem from economic, hydrological, or environmental (pollution) grounds. Causes may be found in pollution of the water, security reasons, economic reasons, shipping, hydropower, flooding, and low water levels. Of course conflicts over water also exist within a country because of the interests of different users. Some of these causes will be explained in this article.

The time span of the conflicts may be large and the conflict may continue to exist for decades. Within these decades the intensity varies, however, from a fierce diplomatic struggle to a sleeping unresolved issue.

Most, if not all, water conflicts between states deal with surface water. This appears logical because the vast majority of people depend for their fresh water on surface resources. We may however keep in mind that the potential for conflict over groundwater and aquifers will become more likely with the growing scarcity of surface water.

4.2. Methodologies for Conflict Prevention and Resolution

4.2.1. Analysis Methods

An example of an analysis method for the Rhine is the "Rhine alarm model." When water becomes heavily polluted, effective forecasting is essential for water users (such as water supply companies and water boards) so that they can take the necessary measures in time.

The ICPR and the CHR jointly developed the alarm model for the Rhine in 1990, as mandated by the eighth Rhine ministers' conference. Alarm stations along the

Rhine deploy the alarm model for the Rhine in order to forecast the distribution of harmful substances when water is polluted as a result of an accident. Water supply companies and water boards use the Rhine alarm model in the implementation of measures to be taken, such as halting the intake of non-purified water.

4.2.1.1. Working method of the Rhine alarm model

In spite of all preventive action, polluted water might still flow into the Rhine. Time is then of essence. Above all, those concerned downstream must be warned. Therefore, the ICPR has installed a warning and alarm system "Rhine." The alarm model for the Rhine covers the Rhine river from the Bodensee Lake to the North Sea, including the Aar, Neckar, Main, and Moselle tributaries. Between Basel and the German-Dutch frontier, six main international warning centers "share" the Rhine. Two more such warning centers are located on the Moselle. Each main international warning center is responsible for a certain stretch of the Rhine or for the tributaries. In case of an accident, the warning center concerned sends a "first report" to all centers downstream, as well as to the ICPR secretariat in Koblenz. Normally, this report is classified as "information" only; a "warning" is only produced when water quality is seriously threatened. Those concerned downstream may then take preventive action as rapidly as possible in order to prevent – or at least limit – expected damage.

The model calculations involve the location and conditions of the initial pollution, the decomposition and drift capacity of the harmful substances, the discharges and/or water levels, and the geometry and dispersion. The model has been calibrated using tracer tests.

The alarm model for the Rhine calculates the concentration time as well as the time and scope of the maximum concentration in the river, for the location's input. If required, the progress of the pollutant wave can be envisaged from the source to the North Sea. The progress time of harmful substances can be forecast with an accuracy of about 89 percent. Concentration calculations have an accuracy of about 95 percent.

The Rhine alarm model was used as the basis for formulation of an alarm model for the Danube. The Danube model also calculates the cross flow of the pollution across the river. This additional feature was also included in the latest version of the Rhine alarm model at a later stage. Although for many years the prime aim of the ICPR was the improvement of water quality, no water quality models were used on a large scale.

4.2.2. Dialogue, Consultation, and Exchange of Information

Policy analysis aims to clarify and rationalize the various options for management actions for a given problem. It provides information on the pros and cons of the range of choices that can be made. It therefore prepares for decision making, but does not take the actual decision. Policy analysis pays attention to implementation feasibility (financial, legal, and organizational aspects), but it does not deal with the actual implementation. The product of a policy analysis is an overview of possible and feasible alternatives with an assessment of their socioeconomic, ecological, and institutional impacts. An overview is generally presented in a scorecard, showing the scores on the evaluation criteria in which the impacts are expressed.

4.2.2.1. Context of Policy Analysis

Policy analysis is part of the so-called "policy cycle." Six phases can be distinguished within the policy cycle, with different political weights (see Figure 7).

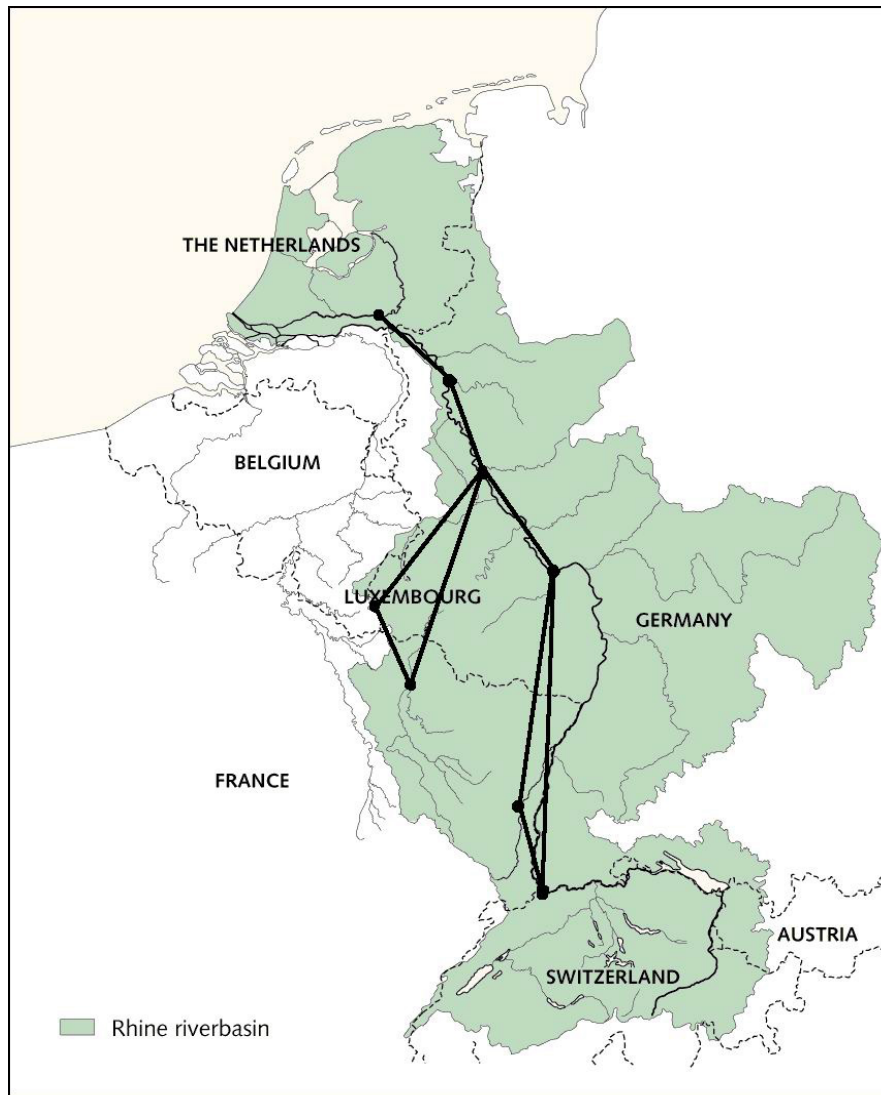


Figure 6. International main warning and alarm centers in the Rhine basin (ICPR)

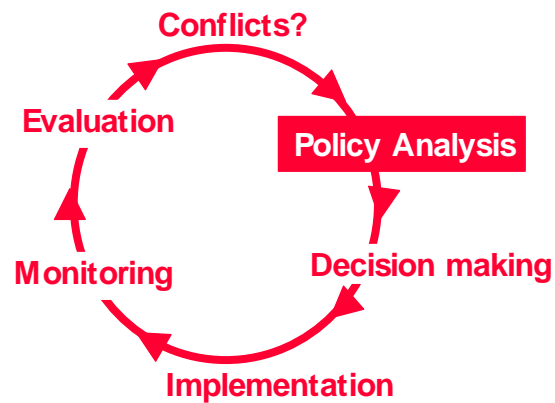


Figure 7. The policy cycle

In this cycle six phases can be distinguished:

1. *Conflict*. Signals from society indicate that there is a problem: public awareness is raised. For some period of time there may be a difference of opinion among interest groups within society about the extent, causes, and effects of the problem. This phase ends with a common notion that there is a need for (governmental) intervention (policy making). Opinions about the possible or necessary direction of this intervention may, however, still differ very much among all the parties involved.
2. *Policy analysis*. In this phase alternative solutions are generated and evaluated against a common set of criteria representing the different relevant spheres of impacts and interests (environmental, economic, cultural, and so on).
3. *Decision making*. The government weighs the presented alternatives and decides on an adequate policy and a corresponding set of measures and actions (the "plan"). Depending on the case and the legal setting, the plan – or elements thereof – may be the subject of further public and political debate, formal public hearing, formal parliamentary consent or intervention, and appeal in an administrative or civil court, or a combination of these.
4. *Implementation*. The (altered) plan is implemented. Investments are made and engineering takes place. The attention of society and politics may fade out.
5. *Monitoring*: A monitoring program is executed to assess the effectiveness of the implementation of the plan and identify any unforeseen effects.
6. *Evaluation*. Vigilance is required because new developments, new social opinions and values, and new knowledge and understanding may require additional measures, or in the course of time may lead to a new iteration in the policy cycle.

The objectives of a policy analysis are in short:

- to clarify and rationalize alternative policy and management solutions in objective terms
- to gather and present information to all interest groups involved in the project and those affected by the consequences
- to prepare for, but *not* to make, a final decision.

Somlyódy (1991) promoted the adoption of this methodology, which he referred to as *system analysis*, in the case of Gabčíkovo–Nagymaros, the debate between Slovakia and Hungary on the construction of hydropower dams in the Danube. His conclusion in 1991 was that a systematic assessment was lacking for this project. A comprehensive assessment based on common scientific insight and commonly available data is still missing to this day. This may be part of the reason why even now there is no broad agreement between Slovakia and Hungary, and no broad agreement internally in both countries about the way the Gabčíkovo–Nagymaros project should be going. This article does not fill this void but does attempt to present a concrete structure for the forthcoming technical assessments and political decisions.

A policy analysis starts off with a detailed examination of the problem. This phase creates a broad understanding of the actual situation and the requirements of possible solutions. Once the backgrounds of the problems are known, solutions can be conceived. A systematic and well-structured approach is needed to generate the information necessary to decide which alternative is best. The alternatives are evaluated on a limited number of criteria, which should render a clear representation of the effects of each. The evaluation for each criterion should have a sound scientific basis. There should be unanimity along the involved groups on the evaluation of the different alternatives for each criterion.

This information can then be presented in an evaluation matrix or scorecard, which shows the impacts of the alternatives in a clear and comprehensive way. In an evaluation matrix, columns show the alternatives and rows are formed by the criteria. The impact of an alternative on a certain criterion is listed in the corresponding row. Table 3 gives an example of an evaluation matrix. Impacts can be listed quantitatively or qualitatively with respect to a reference situation.

	<i>Alternative 1</i>	<i>Alternative 2</i>	<i>Alternative 3</i>	<i>Etc.</i>
Criterion 1	+	0	-	-
Criterion 2	33	7	50	12
Criterion 3	etc.	...	...	...
Criterion 4	...	...	...	...
Etc.	...	...	...	...

Table 3. Example of an evaluation matrix

4.2.2.2. *Quality criteria of the decision-making process*

The methodology of policy analysis, as presented so far, provides a theoretical framework related to the policy cycle. In any practical application of the method it becomes clear that every case has its unique characteristics. Nevertheless, all stages of the process can usually be recognized. If this is so, one may use this knowledge, and the applicable legal and institutional setting, in the design of the analysis and the decision-making process. Further practical criteria may be derived from recent developments in the water sector in the Netherlands, which facilitate and improve the quality of the decision-making process while also speeding up the pace of the process.

In 1995 in the Netherlands, some 200,000 people had to be evacuated because of imminent flood risks from the rivers Rhine and Meuse. Within months a *lex specialis* (special law) was passed to construct or improve about 750 km of dikes and levies before the year 2000. Although the pressure to "start digging" was high, much attention was paid to public involvement and the quality of decision making. Under the so-called Delta Act 1995, environmental quality, landscape integrity, and historical and cultural values are as much part of the project design as the objective to protect the low-lying parts of the country against flooding.

Driessen et al. (1997) carried out an investigation into the question to what extent the Delta Act 1995 had promoted the efficiency and quality of the decision-making process on the river defense works. A broad acceptance of the outcome of the process, by the general public as well as by the different regional and local administrative and executive bodies, was in this case considered to be a measure for a good quality of decision making.

Without going into the details of this particular Dutch case, it is important to point out that this study has identified seven quality criteria that in our view bear broader relevance in the design of the decision-making process for large infrastructure projects. These criteria pertain to the *process* of decision making. They are translated into seven steps, with corresponding questions and criteria that make these questions operational in a participatory decision-making process:

1. *Involvement of public and private parties.* The central question is how the interests of those involved and affected are safeguarded and how this is manifested.
Criterion: have the interest groups been able to bring forward their opinions?
2. *Attention to relevant interests.* The objective is to give sufficient attention to all relevant interests in the decision-making process.

- Criterion: have the interests been mapped (safety, economy, landscape, nature, cultural values, etc.)?
3. *Alternative plans*. Where there is a conflict of interests, different alternative plans have to be developed.
Criterion: have alternatives been developed, and have they been compared for the different conflicting interests (this is the policy analysis phase)?
 4. *Options for compensation*. Options for compensation in material or financial terms will have to be investigated.
Criterion: have compensation options been developed, and have they been used to try to solve potential conflicts?
 5. *Formal hearing of public opinion*. Hearing public interest groups and private interest groups may lead to consensus.
Criterion: have interest groups been able to give their opinion about the plans, and have the authorities made clear what they have done with this?
 6. *Motivation of the decision*. Finally a weighing of interests takes place. The formal process of doing this is of importance.
Criterion: has the decision been clearly justified by the authorities?
 7. *Legal procedures for appeal*. For interest groups a legal appeal may be the last resort to realize their wishes.
Criterion: is there a clear system for citizens to file objections to a project or appeal to an administrative or civil court?

Driessen et al. (1997) consider these seven criteria to be “explanatory variables” for social and administrative acceptance. If the opinion about each of the criteria is positive, then there will be broader acceptance. The authors point out that besides the seven process-oriented criteria, other factors may play a role. These are for instance the project organization, project management, project budget, and the potential to connect one project to another and to identify “win-win solutions.” Finally, it may be added, *acceptance* is not necessarily the same as *approval*. In a democratic society however, the outcome of a decision-making process that was carried out to the highest quality may be acceptable, even though not everybody favors the outcome.

4.2.3. Monitoring and Assessment

After the creation of the International Commission for the Protection of the Rhine against Pollution (ICPR) in 1950, the ICPR started to investigate the type and extent of pollution. An international monitoring network was set up. The comparability of analysis results was improved. This proved to be a laborious exercise, as measurement and analysis methods differed in the participating countries. This important activity provided the common basis for an objective assessment of the water quality. Later this approach served as an example for many other international relations. Monitoring and assessment guidance for transboundary waters, prepared and agreed upon in common understanding, created the basis for the formulation of joint measures. Sustainable transboundary cooperation needs a thorough, indisputable, scientific assessment of facts. Doubts about facts frustrate international cooperation. Since 1970, scientific institutions in six Rhine countries have cooperated in the International Commission of the Hydrology in the Rhine basin. The Commission harmonizes hydrological data gathering and handling, develops hydrological models, and sometimes executes research projects for the ICPR.

4.3. Diplomatic Resolution Methods

4.3.1. Negotiation

Negotiation is a form of conflict resolution in which the parties try to resolve their dispute and reach a solution without the help of a third party. Negotiations are informal in nature, and have the best chance of success if the parties are strongly committed to reach a solution, and the cultural, economic, and political differences between them are not too large.

4.3.2. Mediation

The fact that the parties to the conflict have agreed beforehand to turn to mediation or other kinds of conflict resolution in the case of a dispute between them may be important. The relations and communications between the parties in general are also important. In a situation where there are differences or disputes between them in other areas, these may influence the process and outcome of the current dispute. Furthermore, differences in culture or religion may make it difficult to reach solutions in other fields. To be able to reach a solution it is important to know whether the parties have a clear and identical view of the problem. When the problem is clear, will they be willing to accept a solution on a give and take basis? And, not unimportantly, do they have the authority to accept a solution?

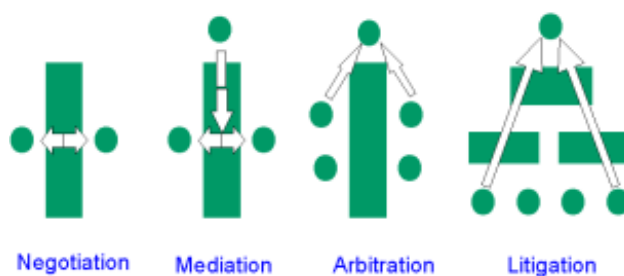


Figure 8. Schematic figure of different negotiation methods

When parties to a dispute are not able to reach a solution by negotiation they may turn to mediation. By agreeing to mediation, the parties acknowledge that their dispute is a matter of (international) concern. However, a third party cannot force mediation upon the disputing parties.

Mediation can be seen as facilitated negotiation. The parties ask a third party (a person or a third state) with an independent view to guide the process and help them to reach a solution. A crucial factor in this process is that the mediator has to be acceptable to both parties. One of the predominant tasks of a mediator is to keep the parties talking. The involvement of a mediator may range from encouraging the parties to resume negotiations (known as "good offices") on the one hand, to the investigation of the dispute and active participation in finding a solution on the other. This solution may be hard to find because the parties have different interests. This, together with the emotional involvement attached to the conflict, often makes a rational solution difficult to achieve. In this situation, the mediator has to interpret and transmit each party's proposals, and present his or her own possible solutions to the conflict.

Mediation is an attractive option in a conflict situation because a solution can be reached quite quickly and the costs are low. It has positive aspects because it can be satisfactory for both parties. They both may gain in the conflict, they may restore troubled relations, and because they are directly involved, the parties feel more obliged to follow the outcome of the mediation than they probably would feel in the case of a court decision. During the mediation process, the parties may turn to

advisors, for instance in the field of finance or law, to help them reach a better solution. An important and positive factor in the mediation process is the equality of the parties. For an acceptable outcome, the parties should negotiate on a basis of equality and try to reach a reasonable and equitable solution to their problem. This does not mean the outcome has to be equal, only that the solution must be reasonable to all involved.

One of the less fortunate elements of mediation is that the outcome of mediation is always some kind of compromise. The result may be equitable but the parties may not always feel they gain (enough). If governments believe they can win a dispute, mediation may be out of the question, and a party may require a court decision to compel the other party to comply. Furthermore, mediation will only be successful if the continuation of the conflict outweighs the costs of a resolution. Another element that negatively influences the chances for success in mediation is the fact that the proposals presented by the mediator are not binding. Parties to the dispute do not commit themselves to accepting the mediator's suggestions for a resolution, although since they are involved directly in the process the chances for implementation of a solution is higher than it would be in the case of, for instance, arbitration.

These questions are important for the outcome of the mediation process. If mediation fails, and the parties cannot reach a solution, they may turn to arbitration or judicial settlement.

4.3.3. Arbitration and Judicial Settlement

Arbitration and judicial settlement, however, may not be as satisfactory to the parties as mediation. These types of conflict resolution are different from the means of settlement mentioned before. In negotiation and mediation the parties remain in control of the process with regard to the dispute, and may accept or reject a proposed settlement as they see fit. In the case of arbitration and judicial settlement the process is more formal and the decisions are binding. These two processes are known as means of legal settlement, and the decisions made are based on rules of international law.

4.3.4. Arbitration

When the parties turn to arbitration, they do so out of free will. They first have to set up a tribunal to handle the dispute. If no agreement has been reached beforehand in a treaty or otherwise, the first thing the parties have to do is decide what kind of tribunal should be appointed. This may be a difficult task to accomplish because of the already existing dispute. Many treaties therefore have some articles on how to handle disputes between the member states should they occur. These articles may specify how a tribunal should be appointed, and the operation of the tribunal may be outlined (how many arbitrators, what terms, what criteria that shall apply to reach a decision). When a dispute is settled by arbitration, the parties plead their case before an arbitrator or arbitrators; they do not negotiate, as they would in a mediation process. After the pleading they await the decision of the arbitrator. The decision in arbitration is binding. The arbitrator may decide in the dispute on a course of action with provisions for enforcement.

4.3.5. Permanent Court of Arbitration

This court is located in The Hague, the Netherlands. Strictly speaking, it is not a court because it is not composed of a fixed body of judges. It consists instead of a panel of persons nominated by the contracting states, "of known competency in questions of international law, of the highest moral reputation and disposed to accept the duties of an arbitrator" (Shaw, 1986, pp. 513-14). Between 1900 and 1932 the Permanent Court of Arbitration (PCA) decided on some twenty cases; after this period only a few

cases were presented to it. From the 1990s onward there has been a revitalization of the PCA, and in the last ten years there have been at least seven cases. The PCA has a permanent organizational structure and can facilitate the conflicting states in their arbitration.

A negative element of arbitration is that it may take a long time compared with mediation and the costs are higher. Furthermore, the parties may feel less involved in the process, and therefore less willing to implement the decision made by the arbitrator. Although the agreement reached by the arbitrator is binding, an arbitrary process in most cases does not bring parties closer to each other when the relations between them are already troubled. After the award there will still be troubled relations, which may cause disputes in the future. On top of this there is, with a few exceptions, no third party who is able to enforce the decision if the parties should refuse to implement it. As mentioned before, the arbitral decision is binding, but it is not necessarily final. Parties may, when the treaty allows this, revise, appeal, or nullify the decision. In disputes when arbitration is not an option, the parties may turn to another form of judicial settlement, for instance a court.

4.3.6. Courts

When none of the aforementioned procedures leads to a solution in a dispute, the disputing parties may turn to a court, predominantly the International Court of Justice (ICJ). The ICJ is also located in The Hague. It is a standing court and has appointed judges. The court is less flexible than a tribunal. Only states may appear before it to settle their disputes in accordance with international law. Prior to the settlement of a case states will have to give their consent to the court. If not all parties involved are willing to give their consent, the court has no jurisdiction to decide on the matter. States can only bring their dispute before the ICJ voluntarily, and the court itself has no means of taking the initiative to settle a dispute. After the award the decision of the ICJ is binding upon the parties, but the court has no means of enforcing a decision.

4.3.7. Regional Organizations

As well as the organizations mentioned earlier, there are regional organizations of which states are members. Most of these organizations have some kind of dispute resolution process in their statutes, varying from mediation, to ICJ, to their own court, such as the European Court. These organizations however have never been used for water disputes.

4.4. Public Participation in the Rhine Region

Public participation in the Rhine region has gained importance over the years. Public participation has been incorporated in recent conventions and regulations. A short explanation of a few recent regulations that have had a large impact follows.

4.4.1. The Aarhus Convention

Although regional in scope, the significance of the Aarhus Convention is global. It is by far the most impressive elaboration of Principle 10 of the Rio Declaration, which stresses the need for citizens' participation in environmental issues and for access to information on the environment held by public authorities. As such it is the most ambitious venture in the area of "environmental democracy" so far undertaken under the auspices of the United Nations.

(Kofi A. Annan, Secretary-General of the United Nations)

The UNECE Convention on Access to Information, Public Participation in Decision-Making, and Access to Justice in Environmental Matters was adopted on June 25 1998 in the Danish city of Aarhus at the Fourth Ministerial Conference in the "Environment for Europe" process.

The Aarhus Convention is a new kind of environmental agreement. It links environmental rights and human rights. It acknowledges the right for all citizens today and for generations to come to live in a healthy environment. It establishes that sustainable development can be achieved only through the involvement of all stakeholders. It links government accountability and environmental protection. It focuses on interactions between the public and public authorities in a democratic context, and it is forging a new process for public participation in the negotiation and implementation of international agreements.

The subject of the Aarhus Convention goes to the heart of the relationship between people and governments. The Convention is not only an environmental agreement; it is also about government accountability, transparency, and responsiveness. The Aarhus Convention grants the public active and passive rights, and imposes obligations on parties and public authorities regarding access to information and public participation. It also regulates public access to justice.

The Aarhus convention is based on three pillars:

- the right to access to environmental information (arts 4–5)
- public participation in the making of environmental decisions (arts 6–8)
- access to justice in environmental matters (art. 9).

Sixteen countries were required to ratify, approve, accept, or accede to the Convention in order to bring about it into force. By December 2001 seventeen states had ratified the Convention, while twenty-eight states and the EU are signatories to it. The Convention entered into force on October 30 2001.

Since the adoption of the Convention, two meetings of signatories have been held. As a result of these, five task forces and working groups have been established, covering the topics of compliance, pollutant release and transfer registers, genetically modified organisms, electronic information tools, and access to justice. Also the meeting of signatories has explored the issue of strategic environmental assessment, and the signatories have engaged themselves in the drafting of a new protocol on the issue.

The EU, as one of the signatories, will implement the Convention into EU regulations, which will lead to adaptations in some existing regulations, for example the regulation with regard to information sharing. Just as countries have to implement the Convention in their national system of regulations, the EU has to implement it within the EU institutions.

4.4.2. Public Participation in European Water Policy

The transition of water management from management on a national level to management on an international level is taking place today. Next to existing river basin organizations (such as the ICPR), the predominant organization covering Europe is the European Union (EU). The EU deals with almost all matters within its member states, including the environment and water. Developments over time have led to increased public participation, not only on a national but also on an international level.

During the last decade the increasing demands by EU citizens and environmental organizations for a healthier environment and cleaner waters have been evident. With the signing of the Aarhus Convention the EU took a large step forward in public participation. Also, in response to these demands, a new European Water Policy was adopted in December 2000: the EU Framework Directive.

During the six years of preparation of this European water policy, all interested parties, such as local and regional authorities, water users, and non-governmental organizations (NGOs) were invited to comment. In 1996 some 250 delegates attended a conference to conclude the process. Among the participants were representatives of member states, regional and local authorities, enforcement agencies, water providers, industry, agriculture, and not least, consumers and environmentalists. The outcome of the conference was a widespread consensus that, although considerable progress had been made in tackling individual issues, water policy was fragmented, in terms of objectives and of means. All parties agreed on the need for a single piece of framework legislation to resolve the problems: the EU Water Framework Directive.

4.4.2.1. Targets

The main targets of the EU Water Framework Directive are to establish a framework for the protection of inland surface waters, transitional waters, coastal waters, and groundwater that:

1. Prevents further deterioration and protects and enhances the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems.
2. Promotes sustainable water use based on a long-term protection of available water resources.
3. Aims at enhanced protection and improvement of the aquatic environment *inter alia* through specific measures for the progressive reduction of discharges, emissions, and losses of priority substances, and the cessation or phasing out of discharges, emissions, and escape of important hazardous substances.
4. Ensures the progressive reduction of pollution of groundwater and prevents its further pollution.
5. Contributes to mitigating the effects of floods and droughts.

With regard to international river basins, the member states have to coordinate among themselves the program of measures to be taken to reach the targets that have been set. This coordination may be by member states or existing river basin commissions (that is, the ICPR).

The Water Framework Directive has to be implemented in national legislation within three years. As member states are responsible for the implementation of the Water Framework Directive, each state has to implement the Directive in its national water policy. In the Netherlands, this national water policy has to be implemented in the four different international river basins (the Scheldt, Meuse, Rhine, and Ems). The operational management of the national policy for the river basin is the responsibility of the state, the provinces, and the water boards, whereas when reporting environmental objectives to the European Union, the measures taken and the monitoring are duties of the national government. The targets have to be reached in fifteen years, after which new ones will be set.

A river basin is the whole area of land from which all-surface run-off flows through a sequence of streams, rivers, and lakes into the North Sea at a single river mouth, estuary, or delta. In the case of the Rhine, this means it extends even beyond EU territory.

For the Netherlands, the Water Framework Directive defines not only rivers and lakes, but also "transitional waters." The transitional waters are bodies of surface water in the vicinity of river mouths, which are partly saline in character as a result of their proximity to coastal waters, but are substantially influenced by freshwater flows. This indistinctness is typical of the Water Framework Directive, and several subjects need to be more fully defined in the near future.



Figure 9. EU member states

The key subjects on the European level are general protection of the aquatic ecology, specific protection of unique and valuable habitats, protection of drinking water resources, and protection of bathing water.

The Water Framework Directive concerns itself predominantly with water quality, and less with water quantity, a factor of major importance to the Netherlands.

All the elements of the Water Framework Directive must be set out in a plan for the river basin. This plan is a detailed account of how the objectives set for the river basin (ecological status, quantitative status, chemical status, and protected area objectives) are to be reached within the timescale required. The plan will include the characteristics of the river basin, a review of the impact of human activity on the status of waters in the basin, an estimate of the effect of existing legislation and the remaining "gap" to meeting these objectives, and a set of measures designed to fill the gap. One additional component is that an economic analysis of water use within the river basin must be carried out to enable a rational discussion on the cost-effectiveness of the various possible measures to take place.

4.4.2.2. Combined Approach

Historically there has been a dichotomy in approaches to pollution control at European level, with some controls concentrating on what is achievable at the source through the application of technology, and some dealing with the needs of the receiving environment in the form of quality objectives. Each approach has potential flaws. On the one hand, source controls alone can allow a cumulative pollution load that is severely detrimental to the environment, where there is a concentration of pollution sources. On the other hand, quality standards can underestimate the effect of a particular substance on the ecosystem, because of the limitations of scientific knowledge regarding dose-response relationships and the mechanics of transport within the environment.

For this reason, a consensus has developed that both are needed in practice – a combined approach. The Water Framework Directive formalizes this. On the source side, it requires that as part of the basic measures to be taken in the river basin, all existing technology-driven source-based controls must be implemented as a first step.

The framework entails the development of a list of priority substances for action at EU level, prioritized on the basis of risk; then the design of the most cost-effective set of measures to achieve load reduction of those substances, taking into account both product and process sources.

On the effects side, it coordinates all the environmental objectives in existing legislation, provides a new overall objective of good status for all waters, and requires that where the measures taken on the source side are not sufficient to achieve these objectives, additional ones are required.

4.4.2.3. Public Participation

The role of citizens and citizens' groups will be crucial in making European rivers cleaner.

There are two main reasons for an extension of public participation. The first is that decisions on the most appropriate measures to achieve the objectives in the river basin management plan will involve balancing the interests of various groups. The economic analysis requirement is designed to provide a rational basis for this, but it is essential that the process is open to the scrutiny of those who will be affected.

The second reason concerns enforceability. The greater the transparency in the establishment of objectives and the reporting of standards, the greater the care member states will take to implement the legislation in good faith, and the greater the power of the citizens to influence the direction of environmental protection, whether through consultation or, if disagreement persists, through the complaints procedures and the courts. Caring for Europe's waters will require more involvement of citizens, interested parties, and non-governmental organizations (NGOs). To that end, the Water Framework Directive will require information and consultation when river basin management plans are established. The river basin management plan must be issued in draft, and the background documentation on which the decisions are based must be made accessible. Furthermore, a biannual conference will be organized in order to provide for a regular exchange of views and experiences in implementation.

4.4.2.4. Streamlining Legislation: Seven Old Directives to be Repealed

One advantage of the Framework Directive approach is that it will rationalize EU water legislation by replacing seven of the "first wave" directives: those on Surface Water, and two related directives on Measurement Methods and Sampling Frequencies, and Exchanges of Information on Fresh Water Quality; the Fishing Water, Shellfish Water, and Groundwater Directives; and the Directive on Discharges of Dangerous Substances. The operative provisions of these directives will be taken over in the Framework Directive, allowing them to be repealed.

4.4.2.5. Getting the prices right

The need to conserve adequate supplies of a resource for which demand is continuously increasing is also one of the drivers behind what is arguably one of the Directive's most important innovations – the introduction of pricing. Adequate water pricing acts as an incentive for the sustainable use of water resources, and thus helps to achieve the environmental objectives under the Directive.

Member states will be required to ensure that the price charged to water consumers – such as for the abstraction and distribution of fresh water and the collection and treatment of wastewater – reflects the true costs. While this principle has a long tradition in some countries, this is currently not the case in others. However, derogations will be possible, for example, in less-favored areas or to provide basic services at an affordable price.

4.4.3. ICPR and Public Participation

An important aspect of the management of international river basins is public participation. Several international declarations advocate public participation in water management. However, there is little regulation of this area in the ICPR.

For years the ICPR has published reports and actively disseminated them. It also regularly organizes conferences.

Since the early 1990s, river commissions from the region, like the Central Commission for the Rhine Navigation, the Moselle and Sarre Commission, the Lake Constance Commission, and even the Elbe Commission (the Elbe is not a tributary) have had observer status at the Plenary Assembly and the meeting of the ministers of the ICPR. Non-governmental organizations have been invited to both meetings since 1998. To qualify as an observer, NGOs should meet certain criteria, the major one being in practice that they deal with Rhine issues and are international. The Plenary Assembly decides on recognition, and in July 1998 the first nine NGOs were recognized. The recognized NGOs cover the interests of nature conservation, landscape planning, waterworks, and the chemical industry. The coordination group decides on inviting recognized NGOs and external experts for meetings of the Plenary Assembly. It takes care that all different interests involved are represented equitably. The coordination group is closed to the NGOs. The coordination group rejected an application of the International Commission for the Hydrology in the Rhine Basin for observer status, as the written goals of this commission compete with the goals of the ICPR.

Since 1998, the NGOs can also participate in the (permanent) working groups as observers or as external experts. The working groups may decide in cooperation with the chair of the ICPR whether to accept the presence of NGOs at their meeting. Some working groups have held preparatory meetings before the official meeting, in which NGOs participated. It is only recently, since 2001, that NGOs have been allowed to contribute to all working group meetings.

The composition of the national delegations is the exclusive responsibility of the state concerned. Each member state is totally free to organize national preparatory meetings with NGOs or other forms of public participation on Rhine issues.

5. WATER-RELATED CONFLICTS (OBJECT OF CONFLICTS)

5.1. Navigation

Due to its geographical situation, the Rhine was from early times the most disputed border between the Roman and Germanic people in northwest Europe. Between the frequent wars, regional Rhine rulers tried to promote transboundary interests. Specific agreements about navigation, fisheries, and pollution were concluded. The sectoral approach of these issues led to optimal conditions for one interest. Some other interests were heavily damaged by these conditions.

Until the nineteenth century some physical obstacles hindered Rhine navigation to a certain extent. The many rulers along the river caused major difficulties, and ships had to pay tolls to them. Several attempts to eliminate the tolls by force failed. In the Peace Treaty of Vienna in 1815, the Rhine riparian states voluntarily voted for free navigation and elimination of tolls. They created the Central Commission for Navigation on the Rhine (CCR), the oldest still active river commission in the world.

After the First World War, in the 1919 Treaty of Versailles, France forced through the right to construct a lateral canal on its bank. The water distribution between France and Germany in the Rhine between Basel and Strasbourg was to be influenced considerably. This would harm navigation, agriculture, and fishing in the old Rhine and have major effects on the landscape. Soon after the Second World War, France and

Germany voluntarily modified the Versailles regulations by combining two solutions: canalization of the river and construction of lateral channels. This voluntary solution still serves both German and French interests.

5.2. Fisheries

Until 1900 fishing was an important economic activity along the Rhine and its tributaries. The supply of local fish markets was plentiful, particularly with salmon. As far back as 1850, international efforts were undertaken to protect the salmon stocks against over-fishing and to assure an equal distribution of the catches along the Rhine. To settle these problems, the Rhine states concluded a salmon treaty in 1869. The Netherlands Parliament, however, rejected this treaty because it would negatively affect Dutch fishery interests. In 1885 the riparian states concluded another salmon treaty with nearly the same content.

The treaty of 1885 is still in force as no state has denounced it, but since that time navigation and hydropower generation have received higher priority than fisheries and other interests. Weirs and dams made it impossible for fish to migrate to their spawning grounds. Furthermore, the weirs and dams produced higher water levels, changing the velocity and sedimentation conditions in the spawning areas. Thus weirs and dams impeded the reproduction of migratory fish. The Netherlands considerably hindered fish migration by closing the Zuiderzee, the construction of delta works, and the canalization of the Lower Rhine. Figure 10 shows the decrease in the salmon population in the Rhine.

The salmon case clearly shows that one-sided promotion of navigation and hydropower interests harmed the ecosystem and fishery interest despite a treaty on salmon preservation.

5.3. Pollution

Because of the rapid industrialization and growth of the population after 1850, the discharges of organic and inorganic substances into the river became increasingly problematic. After the Second World War, the water quality of the Rhine rapidly deteriorated because of wastewater discharges by industries, agriculture, traffic, and households. Large amounts of heavy metals, pesticides, hydrocarbons, and organic chlorine compounds were discharged into the river, causing severe eco-toxicological problems. In 1950, Switzerland, the Federal Republic of Germany, France, Luxembourg, and the Netherlands created the International Commission for the Protection of the Rhine against Pollution (ICPR). The first years were dedicated to establishing a common understanding of the Rhine problem and to creating a legal and institutional basis for cooperation. Joint monitoring programs were developed, but the first common measures to protect the river against the effects of organic pollution were only taken in 1970.

The ICPR was charged with elaborating a convention to reduce chemical pollution. The Convention on Chemical Pollution, signed by the ICPR contracting parties in 1976, was an outline Convention that, among other provisions, provided for threshold values for the discharge of individual toxic substances into the environment. It largely corresponds to the EC Directive 76/464/EEC of May 4 1976. Once all contracting parties have ratified the Convention, its recommendations will become part of national law and legally binding. The threshold values for concentrations of individual substances fixed in the Convention are applicable to the wastewater of complete industrial sites discharged into a surface water body. They are, above all, based on the available techniques of wastewater treatment, but they also take into account the modification of production techniques and on-site measures applicable to waste water. Within this Convention a list of eighty-three substances has to be treated

as priority (black list). This Convention was concluded in 1976, and the Convention prescribed the definition of emission standards according to the best technical means for “black list” substances and for the best applicable means for the “gray list” substances. A permanent problem is that the best technical means of today are outdated tomorrow. Another complicating factor was the approval of the standards by the European Union, a member of the ICPR since 1976. In particular, the juridical approval of the decisions of the ICPR resulted in time-consuming negotiations with the EU. As a result of these difficulties the ICPR had concluded emission standards for only twelve substances by 1986.

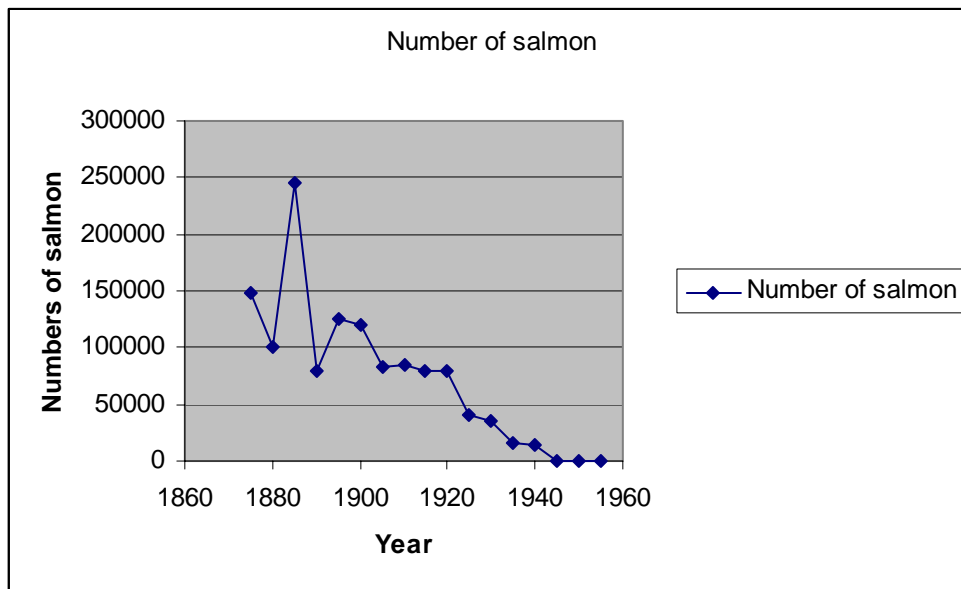


Figure 10. Numbers of salmon in the Rhine

The creation of a positive atmosphere between the participatory states was very important in the first two decades of the ICPR. Confidence, trust, and understanding among the members are crucial factors for successful international cooperation.

The international discussions on criteria for the water quality of the Rhine gave evidence of the contradictory positions of upstream and downstream riparian states. Pollution of the Rhine water reached a climax in the autumn/fall of 1971. During the low water period, the pollution reached such a high level that the Rhine lacked oxygen in its downstream sections (Huisman et al., 2000).

The all-time low of the water quality in 1971 shocked the public and governments in the Rhine states. In 1972 the states decided to take concrete, specific steps to reduce the pollution of the Rhine. Between 1970 and 1985, the countries along the river spent about \$40 billion on building a string of purification plants. The oxygen level rose steadily (Figure 11) and some of the river’s biodiversity returned. However, the purification plants did their work after the pollution had occurred (end of pipe), limiting the effects without tackling the causes. Furthermore, the plants could only eliminate a small amount of the heavy metals in the water.

The definite improvement of the Rhine’s water quality since the 1970s has led the ICPR to work on industrial branches. Since the ministers adopted the Rhine Action Plan (RAP), work no longer concerns individual substances. Instead, the “best available technology” (BAT) is fixed for those industrial branches whose wastewater has a considerable influence on the quality of the Rhine. The BAT is not fixed in treaties under international law but as an ICPR recommendation on the basis of mutual confidence. The approach is flexible and adapted to the experience drawn from the application of the RAP, technical improvement, and the rather different structures

of the national administrations. The major aim of the BAT is to avoid environmental pollution that is not only due to point sources, and thus goes beyond the Convention on Chemical Pollution:

- avoidance of displacing the pollution to other environmental media (waste/soil/air)
- avoidance of processing technologies that involve large quantities of wastewater and of chemical procedures polluting the environment
- disclosure of the amount and composition of all wastewater flows (glass pie principle).

Threshold values for discharges of sum parameters and individual substances, the so-called "indicator parameters" for the BAT in the industrial branch, concerned the above-mentioned measures. The threshold values of discharges mainly concern the load of toxic substances, not their concentrations. The advantages of applying sum parameters are:

- The regulations for each industrial branch remain limited.
- Sum parameters also take into account by-products of production.
- Since analysis does not concern many individual substances, it implies considerably less work.

In the meantime, the ICPR adopted the BAT for the most important industrial branches, and reduced pollution from the point source discharges by more than 80 percent between 1985 and 1995. As shown by the marked decrease of halogenated organic substances (AOX) concentrations and loads, a marked discharge reduction in many non-priority halogenated compounds was also achieved (see Figure 12).

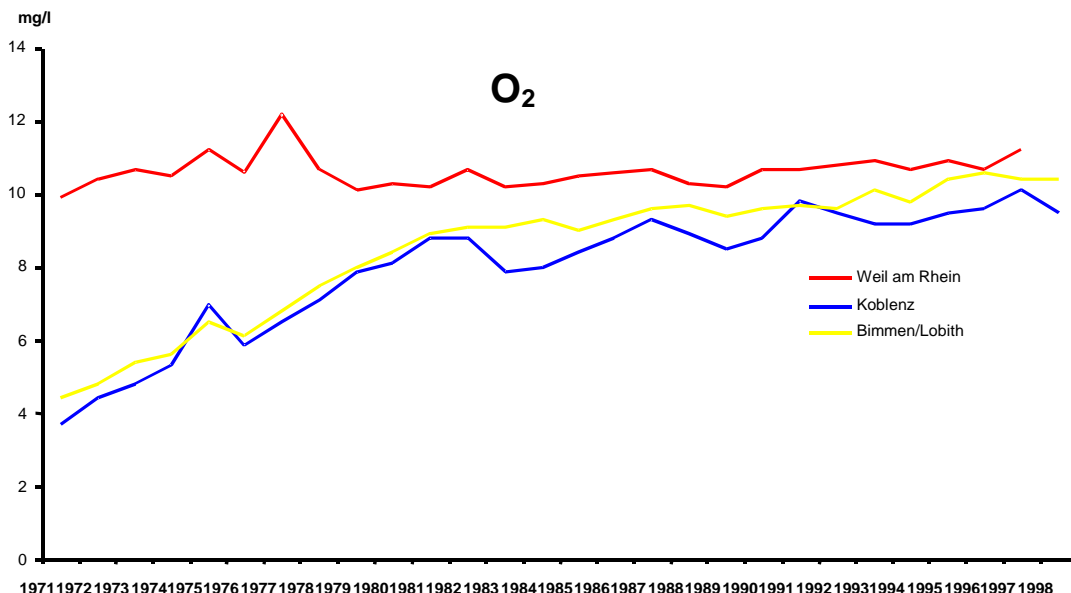


Figure 11. Oxygen measurements in the Rhine

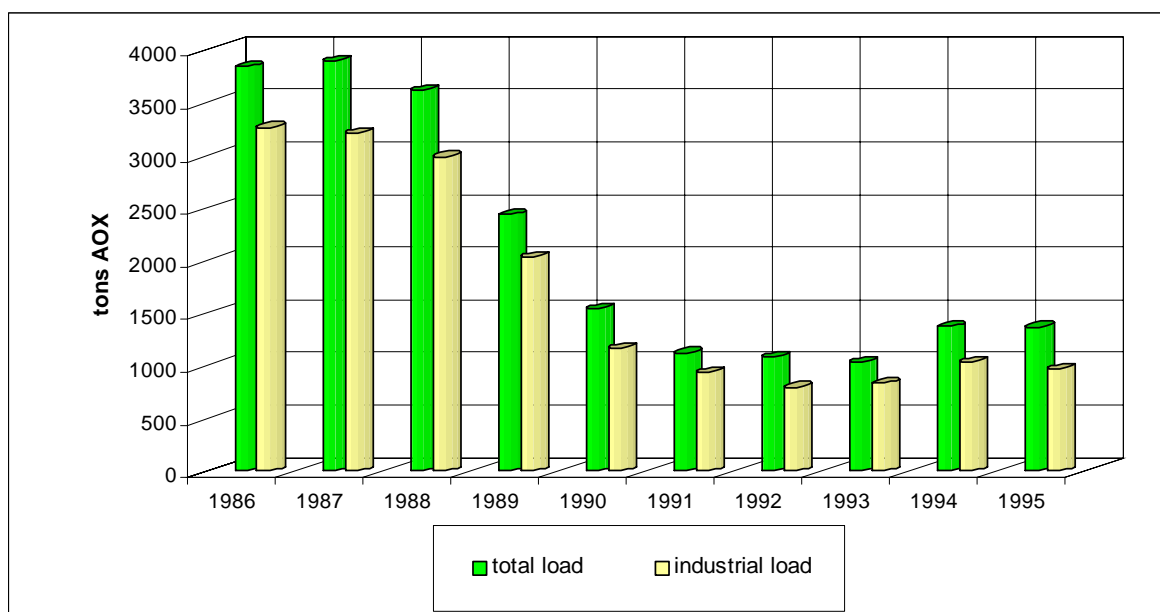


Figure 12. Load of halogenated organic substances (AOX) in the river Rhine

5.4. Salt

The Rhine delta is very vulnerable to salt intrusion from the North Sea. In the densely populated western part of the Netherlands, the groundwater is brackish. In these regions, water from the Rhine is used for the production of drinking water. Also, to prevent salt intrusion in the soil of low-lying polders, Rhine water is used in removing the brackish water and replacing it by fresh water. Before 1900 the salt content of the Rhine did not exceed 10–20 mg Cl⁻/l. The increasing salt content of the Rhine water was a threat to the Netherlands, as the country faced salt intrusion not only from the North Sea but also from the hinterland. In 1932, in Berlin and Paris, the Dutch government protested in vain against the increasing pollution of the Rhine. The higher salt content of the Rhine leads to an increased chloride concentration at the German–Dutch border. Since the 1970s the yearly average has been about 150 mg Cl⁻/l, in dry years even around 200 mg Cl⁻/l, with maximal values around 500 mg Cl⁻/l (see Figure 13). The increasing load of salt in the Rhine influences other functions of the water. The drinking water production has a limit value according to EU-standards of 200 mg Cl⁻/l. For agricultural purposes a chloride concentration higher than 300 mg Cl⁻/l is harmful. The salt load originates (in more than 70 percent of cases) from large industrial plants. Most of the plants discharge a salt solution; however the potassium mining industry in France dissolves solid salt before discharging a vast amount into the Rhine. The ICPR has studied the possibilities of reducing this amount.

In 1976 the Convention for the Protection of the Rhine against Chloride Pollution was signed. Under this agreement, the salt from mining activities had to be stored at the French potassium mines. Later, in 1991, a protocol to this “Salt Treaty” was signed. This stipulated additional storage measures whenever the chloride level at the German–Dutch border exceeded 200 mg Cl⁻/l, and prescribed special measures in the Wieringermeer polder in the Netherlands, where saline seepage water was no longer to be discharged into Lake IJssel. The cost of the measures had to be paid by Germany (30 percent), France (30 percent), Switzerland (6 percent) and the Netherlands (34 percent). According to the Treaty the account on the storage measures in France had to be settled then. Negotiations within the ICPR did not reach an agreement. The only agreement that could be obtained was on the method of calculation of the chloride concentration at the German–Dutch border under different

scenarios. The settlement of the account is now in the hands of an arbitration committee.

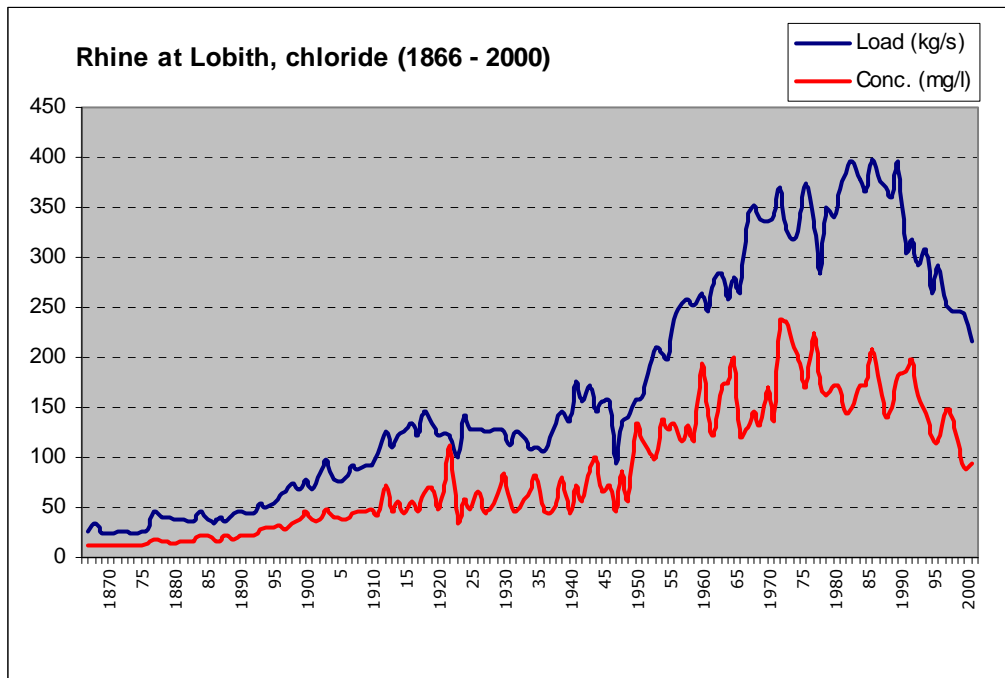


Figure 13. Load and concentration of chloride on the river Rhine

5.5. Accidents

It is a fact that up to 1986 no real progress was made in improving the speed of cleaning up the Rhine. As so often in environmental decision making, a serious accident was needed to enable another step forward.

On November 1 1986 a disaster hit the Rhine: a warehouse at the Sandoz chemical factory near Basel caught fire. The fire in the insecticide store was particularly disastrous, destroying 1,000 tons of agro-chemical substances. The fire was extinguished using about 10–15 million liters of water, a major part of which mixed with the chemicals and flowed into the Rhine. This caused the death of almost all of the aquatic life downstream as far as Koblenz. Forty water works along the Rhine had to stop their intake of water. The Sandoz incident triggered a wave of publicity in all states bordering the Rhine. Political attention was raised, and in a very short time no less than three ministerial conferences addressed the issue of Rhine pollution, finally emerging with the Rhine Action Program of 1987. This is sometimes referred to as the "Salmon 2000 goal."

The Rhine Action Program clearly defined goals to be reached by the year 2000:

- The ecosystem of the Rhine should be improved to such an extent that higher species, such as salmon, would again become indigenous.
- The production of drinking water from the Rhine had to be guaranteed in the future.
- The pollution of river sediments had to be reduced to such an extent that sediment could at any time be applied on the land or dumped into the sea without negative consequences for the aquatic environment.
- An improvement in the protection of the North Sea was necessary.

In this context the ministers agreed on some very challenging and ambitious targets: for example a 50 percent reduction of inputs of dangerous substances between 1985

and 1995, and the return of the salmon by the year 2000. Emission reductions had to be based on an industrial branch approach. Best available technology had to be determined and applied to industrial production and to urban wastewater treatment. Furthermore, measures were formulated to reduce the risk of pollution of the Rhine in case of accidents such as the Sandoz fire.

Thus, the Sandoz accident proved to be a catalyst for the strengthening of transboundary cooperation.

The implementation of the Rhine Action Program has proved to be very successful. Measures have been taken all along the river to prevent pollution, and as early as 1994, the ICPR could report that most of the reduction goals had been reached. In the field of industrial sources the 50 percent target had almost completely been met, and for many substances reductions of up to 90 percent were realized. Difficulties in implementation are still reported in the field of diffuse sources of pollution, especially with respect to agricultural emissions of pesticides and nutrients, and building material.

Additional measures to tackle these problems are being formulated. The actual state of the river shows that an enormous improvement in the water quality of the Rhine has taken place in a very short time. From being the sewer of Europe in the 1970s the Rhine is now a clean transboundary river.

5.6. Ecology

The course of the river was drastically changed in the nineteenth century to improve shipping conditions and to enable the use of alluvial areas for agriculture and other purposes.

Further "corrections" in the riverbed followed in the twentieth century. As a result, the length of the river between Basel and Bingen was reduced by more than 80 km. Meanders and alluvial areas were cut off, causing great changes in the river ecosystem. Other problems were the increase of flow velocity, the erosion of the riverbed, and the drop in groundwater levels.

Perhaps the most challenging goal of the Rhine Action Program was to improve the Rhine ecosystem to such an extent that migratory species could return to their spawning grounds and become indigenous again: the return of the salmon to the Rhine by the year 2000.

The ICPR decided on a range of measures to be implemented in a very short time. The improvement of the water quality of the river was of course a first requirement. Furthermore, extensive programs were developed and implemented to enable salmon to return to their spawning grounds. That meant that costly fish passages were built to circumvent many physical barriers in the Rhine and its tributaries. At the same time habitat improvement measures were taken in many tributaries with the aim of restoring spawning grounds. Parallel action was required in order to create a new stock of Rhine salmon. Salmon eggs were bought and were hatched in special fish hatcheries. Thousands of young fish were released into the river and its branches. At the end of the twentieth century salmon and sea trout returned in the River Rhine, and a special monitoring program was developed to track the behavior of these species.

5.7. Flooding

Flooding is a natural phenomenon. The variation of water levels is part of the natural feature of rivers, constituting a basis for river flow dynamics and the development of floodplains. Various human interventions have altered the river regime and thus affected the flood patterns. In the course of the last two centuries the Rhine lost more than 85 per cent of its natural alluvial areas, as humankind used them for settlements

or agriculture. In addition, the corrections carried out in the eighteenth and nineteenth century have shortened the Upper Rhine by 82 km and the Lower Rhine by 23 km. Flood damage is thus created by the interplay of two independent mechanisms: nature and human intervention, which can result in high water levels. At the same time, humankind increases its investment along the river. This combination of the increase in flood intensity together with the accumulation of investment in areas at risk results in an increase in the risks of damage. The alarming pictures of the disastrous flooding of the River Oder in the summer of 1997 recalled the last great floods of the Rhine in 1993 and 1995. What happened in the Oder area was what people were afraid of in the Dutch Rhine delta in January 1995. Luckily it did not happen there. Along the Oder, however, dikes in different locations could not resist the enormous water pressure. Large areas were flooded in the Czech Republic, Poland, and to a lesser extent in Germany. More than 100 people lost their lives, and flood damage amounted to billions of euros. The population reacted with an unprecedented wave of solidarity for the flood victims.

During the floods of 1993 and 1995, many cities along the rivers Rhine, Moselle, and Meuse were flooded. In 1995, dikes were at risk of bursting in the Netherlands. As a precaution, several hundred thousand people were evacuated in the countries involved. The damage was estimated to amount to several billion euros.

The floods along the Rhine provided a new opportunity to broaden the international cooperation around the river. On the basis of the very positive results of the Rhine Action Program, the Ministers involved charged the ICPR with the development of an international action program to control flooding. The proven spirit of cooperation between the states bordering the Rhine, and the efficient holistic and programmatic approach of the ICPR, should lead to a comparable positive result with regard to reducing the international flooding problems.

The flood events made it clear that:

- Floods are natural events, which must be periodically reckoned with.
- Humankind has aggravated the maximum flood level and the speed of flooding by land development in the catchment area, by river development, and by reducing natural flood storage areas.
- Embankment and other flood protection structures along the Rhine cannot grant absolute protection.
- Settlement and other uses in flood-prone areas present particular damage risks.

Therefore, the EU Ministers of the Environment of France, Germany, Belgium, Luxembourg, and the Netherlands declared (on February 4 1995 in Arles) that they deemed it necessary to reduce flood-related risks as rapidly as possible. It was not acceptable to them that situations arising at that time put lives, property, and the environment at such great risk. Prior to its adoption this declaration had been agreed upon with Switzerland, which is not a member of the European Union.

The Declaration of Arles underlines that measures are required not only in the field of water management, but also in the fields of spatial planning and land use: for example, in connection with agriculture and forestry, nature protection, development of settlements, and recreational use. The river basin commissions for the Rhine, the Sarre/Moselle, and the Meuse were charged to draft action plans on flood defense, integrating measures in the field of spatial planning. In February 1995, the International Commission for the Protection of the Rhine (ICPR) commissioned the project group "Action Plan on Flood Defense" to draft an action plan for the Rhine and its catchment area. The ecological improvement of the Rhine and its floodplains was to be integrated and continued in this Action Plan. As far as spatial planning is concerned, the responsible ministers in France, Germany, the Netherlands, Belgium,

and Luxembourg seized the opportunity of interdisciplinary and transboundary cooperation, and stated in the Strasbourg Declaration of March 30 1995 their intention to set up an international working group, "Spatial planning and preventive flood protection Rhine/Meuse." The European Union supported these activities. The operational program developed on this basis under the name of IRMA (Interreg-Rhine/Meuse-Activities) contributed to a forced implementation of specific measures in the field of flood prevention along the Rhine and the Meuse in the years 1997 to 2001. Considerable international activities on flood defense and flood prevention were started or carried on in other fields of policy or society. These were also used as a basis for the Rhine Basin Action Plan.

The Action Plan on Flood Defense for the Rhine, adopted in January 1998, will be carried out as a phased program so that progress under the program can be evaluated vis-à-vis the overall strategy. The action plan aims at improving the protection of people and goods against flooding while integrating ecological improvements to the Rhine and its floodplains.

Clearly defined action targets with detailed accounts of measures to be pursued simultaneously have been identified for the Action Plan. The measures connected with these targets, listed below, must be carried out in successive stages. The Action Plan aims to address all flood situations, not only extreme events. The targets, though ambitious, are realistic. They require considerable efforts, financial resources, and political commitment in the implementation in order to change current ways of thinking and of resource uses. The Action Plan sets the following targets (reference year 1995):

- *Reduce damage risks.* No increase of damage risks until the year 2000, reduction up to 10 percent by 2005 and up to 25 percent by 2020.
- *Reduce flood stages.* Reduce extreme flood stages downstream of the impounded part of the river up to 30 cm by the year 2005, and up to 70 cm by the year 2020.
- *Increase awareness of floods.* Increase the awareness of floods by drafting risk maps for 50 percent of the floodplains and the areas at flood risk by the year 2000, and for 100 percent of these areas by the year 2005.
- *Improve the system of flood forecasting.* Short-term improvement of flood forecasting systems by international cooperation. Prolong the forecasting period by 50 percent by the year 2000, and by 100 percent by the year 2005.

6. LESSONS LEARNED

Experiences with conflicts and cooperation in the Rhine basin, as described in the earlier chapters, prove the usefulness of river basin organizations.

Although the major Rhine river basin organizations focused and focus on one specific aspect of the river such as navigation, water quality, or research, all river organizations have proved their great importance.

The rules of cooperation for all the commissions are that they are based on consensus between the partners and thus gain support and commitment for their recommendations. The commissions have a fixed funding by either the states or the member institutes, and carry out a program and measures.

One of the prime obligations for the commissions is to publish joint reports on the status of the river and on the progress of implementation measures.

In doing so, the natural confidence of the constituting partners will grow. The political relevance of the work of the commission underlines its importance, although too much political involvement in the work can harm the open discussion among

experts and be injurious to flexibility in the search for common solutions that are of value for the basin as a whole.

A prerequisite for an international basin organization is a national legal basis for acting, a treaty-based performance or a diplomatic memorandum of understanding. A clear description of the rules on how to act in case of a (potential) conflict or disagreement between members needs to be included in the treaty of the organization.

For a river basin organization a coordination authority at all levels, supported by a (technical) secretariat, is of great importance for the continuity of the work.

The secretariat and the members of the organization should formulate clear and attractive common targets and organize stakeholder involvement in planning and implementation of measures.

The sharing of success by the commission and each member state/institute will stimulate mutual confidence and enhance public and political support.

A sound, indisputable scientific assessment of facts supports strongly sustainable transboundary cooperation. In the Rhine basin, the cooperation between the research-oriented International Commission for the Hydrology of the Rhine Basin (CHR), the International Commission for the Protection of the Rhine (ICPR) and the Central Commission for Navigation of the Rhine (CCNR) should be stimulated vigorously.

Finally, a sustainable River Rhine needs a river basin approach for the whole catchment area, with integrated water resource management as the task of one river basin organization, in order to comply with the European Water Framework Directive and to avoid duplicating work between the existing organizations.

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Additional Information

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<http://ccr-zkr.org/>

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Constitution of UNESCO (excerpt)

London, 16 November 1945

The Governments of the States Parties to this Constitution on behalf of their peoples declare:

That since wars begin in the minds of men, it is in the minds of men that the defences of peace must be constructed;

That ignorance of each other's ways and lives has been a common cause, throughout the history of mankind, of that suspicion and mistrust between the peoples of the world through which their differences have all too often broken into war;

That the great and terrible war which has now ended was a war made possible by the denial of the democratic principles of the dignity, equality and mutual respect of men, and by the propagation, in their place, through ignorance and prejudice, of the doctrine of the inequality of men and races;

That the wide diffusion of culture, and the education of humanity for justice and liberty and peace are indispensable to the dignity of man and constitute a sacred duty which all the nations must fulfil in a spirit of mutual assistance and concern;

That a peace based exclusively upon the political and economic arrangements of governments would not be a peace which could secure the unanimous, lasting and sincere support of the peoples of the world, and that the peace must therefore be founded, if it is not to fail, upon the intellectual and moral solidarity of mankind...



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