United Nations Economic Commission for Europe

Convention on the Protection and Use of Transboundary Watercourses and International Lakes

Transboundary flood risk management

Experiences from the UNECE region

UNITED NATIONS

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ECONOMIC COMMISSION FOR EUROPE

CONVENTION ON THE PROTECTION AND USE OF
TRANSBOUNDARY WATERCOURSES AND INTERNATIONAL LAKES

Transboundary Flood Risk Management: Experiences from the UNECE Region

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Note

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The approach to geographical names in this publication is not uniform. English names have been used in some cases and local names in others.

Symbols of United Nations documents are composed of capital letters combined with figures. Mention of such a symbol indicates a reference to a United Nations document.

This publication is based on presentations, discussions and findings of the Workshop on Transboundary Flood Risk Management (Geneva, 22–23 April 2009) organized by the United Nations Economic Commission for Europe (UNECE), the Government of Germany, the Government of the Netherlands and the World Meteorological Organization (WMO). Opinions expressed do not imply endorsement by UNECE, WMO or the Governments of Germany and the Netherlands.

Further information about the workshop, including presentations and the discussion paper, is available at: www.unece.org/env/water/meetings/transboundary_flood_workshop.htm.

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Foreword

Since the beginning of the century, more than 3 million people have been affected by floods in the region of the United Nations Economic Commission for Europe (UNECE), 1.9 million in Eastern Europe alone. Extreme flood events and the economic, social and environmental impacts and losses in human life they cause have significantly increased in recent years. Against this already serious background, enhanced climate variability and climate change are expected to increase the frequency and intensity of floods.

On the other hand, floods are natural phenomena that can also bring benefits: seasonal floodplain inundation is essential to maintaining healthy rivers, creating new habitats, depositing silts and fertile organic material, and sustaining wetlands. The vulnerability to floods mainly depends on human activities – the location of buildings and infrastructure, the existence of early warning systems and emergency planning, appropriate legal and institutional frameworks, etc. An integrated approach to flood management – one that recognizes both the opportunities provided by floodplains for socio-economic activities and that manages the associated risks – is essential for the sustainable development of river basins.

In the UNECE region, as in many other parts of the world, the situation is further complicated by the transboundary nature of water resources. There are more than 150 transboundary rivers in the European part of the region and their basins cover more than 40 per cent of its surface. Thus major flooding events often have impacts in several riparian countries.

Transboundary cooperation on flood risk management is not only necessary, but also beneficial. Early warning by upstream countries can save lives and reduce economic losses. Moreover, cooperation helps to strengthen the knowledge and information base and enlarge the set of available strategies. Widening the geographical area considered in basin planning enables finding better and more cost-effective solutions. Finally, disaster management is highly dependent on early information and requires data and forecasts from the whole river basin.

Numerous challenges hamper effective transboundary cooperation in general and cooperation on transboundary flood management in particular. Lack of capacity and resources, insufficient data, differing institutional structures, lack of political will – and even mistrust in some cases – are serious obstacles. The UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) aims to support the creation of frameworks fostering transboundary cooperation. Within the Convention's programme of work, UNECE closely cooperates with its partners, in particular the World Meteorological Organization (WMO), to provide guidance for transboundary flood risk management.

This publication is based on the discussion and findings of the Workshop on Transboundary Flood Risk Management organized under the Water Convention in April 2009 in cooperation with the Governments of Germany and the Netherlands as well as WMO. It builds on the practical experience from 10 river basins in the UNECE region. The examples are offered here not as good practices, but rather as an analysis of concrete situations, problems encountered and progress made, as well as of remaining challenges and possible solutions.

The publication aims to document practical experience, together with general conclusions, which can be applied throughout the region.

There will always be floods, but appropriate management can greatly reduce their impacts. I hope that this publication will provide inspiration to water managers, policymakers and land planners, and will help to reduce risks and damage from floods in the UNECE region and beyond.

Ján Kubiš
Executive Secretary
United Nations Economic Commission for Europe

Preface

Floods do not respect boundaries, be they national, regional or institutional. Therefore, transboundary flood risk management is imperative – it involves both Governments – as borders are involved – and their people – as risk is involved. However, it is not easy to implement: joint monitoring, forecasting and early warning, coordinated risk assessment and joint planning of measures, and appropriate legal and institutional frameworks are all necessary.

Transboundary flood management has been at the core of the work under the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) since its entry into force in 1996. Although the Convention does not address floods in detail, most of its provisions are fundamental to the management of transboundary floods. Above all, the Convention obliges Parties to prevent, control and reduce transboundary impacts, including those resulting from floods and from unilaterally decided flood protection measures such as dams.

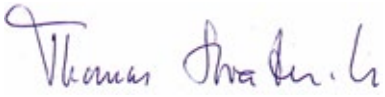
Since the Convention came into force, these core obligations have been elaborated in more detail and expanded in a number of guidelines. Several capacity-building activities have also allowed for strengthening capacity in the region and exchanging knowledge and experience. The Task Force on Flood Prevention and Protection, under the leadership of Germany, has been guiding these efforts. A major achievement was the adoption of the Guidelines on Sustainable Flood Prevention at the second session of the Meeting of the Parties to the Convention in 2000. The Guidelines were complemented by the Model Provisions on Transboundary Flood Management, adopted in 2006. It should be noted that work on floods under the Convention has also had an important influence on the work at the level of the European Union (EU): the Guidelines on Sustainable Flood Prevention served as a basis for the EU Best Practice Document on Flood Prevention, Protection and Mitigation, which led to Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks.

In 2006, the mandate of the Task Force on Flood Prevention and Protection was broadened to take into account the climate change perspective, and the Task Force was transformed into the Task Force on Water and Climate. In the Convention's work programme for 2007–2009, efforts in the areas of floods management mostly focused on exchanging experiences and knowledge between EU and non-EU countries. To this end, a Workshop on Transboundary Flood Risk Management was organized on 22 and 23 April 2009 in Geneva by UNECE, the Governments of Germany and the Netherlands as well as WMO. The workshop aimed to take stock of current problems, recent progress and remaining challenges in transboundary flood management, all on the basis of concrete examples. The workshop was prepared in close cooperation with Parties and non-Parties, who elaborated the case studies by analysing in depth flood management problems in the different basins. Moreover, a background study was prepared to guide the discussions.

This publication condenses the preparatory work, the analysis of the case studies as well as the workshop's discussions and conclusions. Although it provides some general and concrete recommendations, it does not intend to be a guidance document. It also does not address all of the different realities in the region. But it does show that in spite of the very different circumstances, there are common problems, objectives and approaches. The publication identifies a number of useful tools for managing transboundary flood risk.

This publication would not have been possible without the generous contributions of many experts from the whole region to whom I wish to express my sincere thanks.

This publication is a concrete demonstration of the benefits of dialogue, cooperation and exchange of experience in promoting transboundary flood risk management. As the workshop concluded, such exchanges, together with capacity-building activities and concrete projects on the ground, are crucial to sustain progress. The Water Convention is an important tool for fostering such efforts and thereby strengthening cooperation between riparian countries at the technical and political levels.



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Acronyms and abbreviations

APFM	Associated Programme on Flood Management (of WMO and GWP)
CEFRAME	Central European Flood Risk Assessment and Management
CENTROPE	Central European region
COSMO-LEPS	European Consortium on Meteorology-Limited Area Ensemble Prediction System
DSI	Devlet Su İşleri (State Hydraulic Works, Turkey)
DWD	Deutscher WetterDienst
EC	European Commission
ECMWF	European Centre for Medium Range Weather Forecasts
ECO-TIRAS	International Environmental Association of River Keepers
EECCA	Eastern Europe, Caucasus and Central Asia
EFAS	European Flood Alarm System
ENVSEC	Environment and Security Initiative
EU	European Union
EXCIFF	European exchange circle on flood forecasting
EXCIMAP	European exchange circle on flood mapping
FLAPP	Flood awareness and prevention policy
GIS	Geographical information system
GRDC	Global Runoff Data Centre
GSM	Global system for mobile communications
GWP	Global Water Partnership
ICPR	International Commission for the Protection of the Rhine
IFM	Integrated flood management
INBO	International Network of Basin Organizations
IWRM	Integrated water resources management
JRC	Joint Research Centre (of the European Commission)
MIC	Monitoring and information centre
NeWater	New Approaches to Adaptive Water Management under Uncertainty
NHS	National hydrological service
NPD	National Policy Dialogue
OSCE	Organization for Security and Co-operation in Europe
REC	Regional Environmental Center for Central and Eastern Europe
SEE	South-Eastern Europe
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
Water Convention	Convention on the Protection and Use of Transboundary Watercourses and International Lakes
WHYCOS	World Hydrological Cycle Observing System
WMO	World Meteorological Organization

Summary

Summary

Floods are natural phenomena that are necessary for the survival and health of the ecosystem. Floodplains have historically attracted socio-economic development and continue to support high densities of human population. This is particularly important where land resources suitable for human development are scarce. Especially in arid and semi-arid areas, flood waters represent a vital water resource. Floods can, however, also lead to widespread damage, health problems and the loss of human life. This is especially the case where development activities in the river channel and the adjacent floodplain have been pursued without taking into account the associated risks.

An integrated approach to flood management, recognizing on the one hand the opportunities provided by floodplains for development and on the other hand the importance of managing the associated risks, is essential for sustainable development of river basins. The basic aim should be to minimize loss of human life and the economic and environmental damage caused by floods while maximizing floodplains' efficient use. In most cases such an approach represents a shift from the limited current perspective of mere "flood defence" to flood management that is embedded in an integrated water resources management strategy. Such an approach serves broader societal objectives, but it also requires input from various disciplines – not necessarily associated with flood management in the past – and across national boundaries.

Floods do not respect borders, neither national nor regional or institutional. This means flood risk management must be transboundary. The great advantages of transboundary cooperation are that it broadens the knowledge/information base, enlarges the set of available strategies and enables better and more cost-effective solutions. In addition, widening the geographical area considered by basin planning enables measures to be located where they create the optimum effect. Finally, disaster management is highly dependent on early information and requires forecasts and data from the river basin as a whole.

However, numerous challenges for transboundary flood risk management still exist, especially in countries in Eastern Europe, Caucasus and Central Asia (EECCA) and South-Eastern Europe (SEE). These include the lack of (a) a legal framework for cooperation (although cooperation on a technical level often exists), (b) capacity and resources, and (c) public participation and awareness. Expected climate change impacts represent an additional challenge. Different perceptions of the problems among riparian countries are also an obstacle, and should be overcome through communication, joint monitoring and exchange of data. Common understandings of the problems involved and common interests and concerns on the part of riparian countries are necessary preconditions for finding effective solutions.

The United Nations Economic Commission for Europe (UNECE) Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) aims to strengthen measures to protect and ensure the quantity, quality and sustainable use of transboundary water resources and to foster cooperation. The Convention takes a holistic approach based on the understanding that water resources play an integral part in ecosystems as well as in human societies and economies. It is committed to integrated water resources management (IWRM). The Convention's Guidelines on Sustainable Flood Prevention[1] as well as the subsequent Model Provisions on Transboundary Flood Management (see

[1] Available at: http://www.unece.org/env/water/publications/documents/guidelinesfloode.pdf.

annex I) provide specific guidance to support transboundary cooperation on flood management.

Efforts to manage floods on the transboundary scale should be based on the principles of IWRM. Flood risk management strategies should be embedded into the overall joint integrated water resources management of the basin. All riparian countries should take part in the cooperation. Integrated flood management (IFM)[2] helps achieve this.

Existing joint bodies and transboundary agreements often provide the best framework for developing and agreeing on joint flood risk management plans. Specific questions may be regulated by a specific protocol. For example, to address these challenges in the Sava River basin, the Framework Agreement on the Sava was complemented by a specific Protocol on flood management.

Flood risk management strategies should follow all steps of the risk management cycle: preparedness, response, recovery and reconditioning of the management system. Cooperation is necessary at every step. The process of learning from past mistakes – both from the own country and from other countries – needs to be improved. Lessons from past experiences should be assessed, documented, taken into account and shared with other countries. The evaluation should be fed back into the risk management cycle.

Good transboundary communication is essential for good cooperation. Cross-border sharing of hydrometeorological data is important for cooperation and should be endorsed by Governments at all levels, according to the relevant resolutions taken by the national meteorological and hydrological services through WMO. Insufficient communication, lack of data and information exchange between riparian countries are still major obstacles to proper flood risk management. However, numerous positive examples exist, for instance the European Flood Alert System and the cooperation between Austria and the Czech Republic on the Morava River basin.

Awareness-raising, public information and public participation are crucial for flood preparedness, response and recovery. This is also true for low-probability but high-risk events, e.g. extreme floods or dam failures, or relevant aspects of reservoir operation, e.g. floodwater releases and related decision-making processes.

Informal technical cooperation provides various benefits and is in most cases ahead of more formal institutional and political cooperation. In the long run, however, both technical and institutional/political cooperation are required. Political support is needed to make technical cooperation sustainable, long-term and effective in the field of transboundary water management. In many cases, it is not the technical capacity that is missing – i.e. for flood forecasting, early warning and possible measures – but rather the institutionalization of transboundary flood risk management through bilateral and multilateral agreements and continued cooperation. In this regard, the UNECE Water Convention plays an important role, as it represents the international legal framework of reference and supports countries through capacity-building activities, basin-specific projects and the elaboration of guidance documents. A step-by-step approach to gain political support is recommended. Joint flood forecasting, flood warning and exchange of data is currently much more common than is joint flood risk management planning.

In many areas, climate change is expected to increase both the magnitude and the frequency of floods, thereby exacerbating many flood problems. There is still, however, considerable

[2] WMO/GWP, 2004: Integrated Flood Management Concept Paper, APFM Technical Document No. 1, Second Edition.

uncertainty about the exact climate change impacts in many basins. Therefore, flood risk measures and agreements for cooperation should be flexible to adapt to a wider range of future scenarios, and should consider the terms of reference of joint bodies as well as incorporate a cross-sectoral approach.

Numerous tools to support national and transboundary flood risk management are available, but often not widely known in EECCA countries. Existing international framework agreements such as the UNECE Water Convention and the European Union (EU) Directives (e.g. the Floods Directive) should be implemented and enforced, as they support transboundary cooperation on floods. Establishing a mechanism to review compliance with and implementation of the Water Convention could also support transboundary flood risk management.

WMO, through the Associated Programme on Flood Management (APFM) and the newly created Helpdesk for Integrated Flood Management[3], provides important support tools for countries for implementing an integrated approach to flood management. In addition, EU tools such as the European Flood Alert System and those provided by the European Exchange Circle on Flood Forecasting (EXCIFF)[4] and European Exchange Circle on Flood Mapping (EXCIMAP) could be useful for EECCA countries if they were extended east and if Russian translations were provided.

Transboundary flood risk management enables sharing and redistributing risks and resources. In some cases, measures can be more effective if taken in the downstream or upstream country. Sharing benefits and costs across the basin can involve monetary compensation. This is the case in the Vuoksi River basin, where in the event of flooding, Finland may release more water and the downstream Russian Federation will be compensated for loss of hydropower due to this additional release. However, such mechanisms depend on specific local circumstances and need to be negotiated and agreed by the riparian countries.

Regional workshops, training sessions and especially pilot projects are needed to improve transboundary flood risk management in the UNECE region. Technical meetings for information exchange, e.g. based on pilot projects and examples from different countries, could be helpful to sustaining region-wide progress. Preparation of an inventory of knowledge gaps and technical needs could help to improve transboundary flood risk management. Capacity-building and training on both the technical and decision-making issues could help improving both the knowledge base and international cooperation.

[3] See: www.floodmanagement.info.
[4] See: http://exciff.jrc.ec.europa.eu/.

Introduction

Introduction

Floods are natural climate-driven processes. In recent decades, major floods in Europe have caused fatalities, population displacement and great economic loss, and have had huge impacts on nature. At the same time, however, it is important to remember that floods can also be beneficial for society. Appropriate flood management strategies are required to balance development needs and flood risk.

Floods are part of the water cycle and supply floodplains with sediment and nutrients, the main reason for early settlement in and development of floodplains. Both natural characteristics and human interventions and activities in river basins influence the amplitude, frequency, duration and impact of floods. Increasing climate variability and climate change have the potential to exacerbate flood problems in many regions around the world due to their effects on precipitation volume and timing. Population and economic growth are the dominant drivers behind observed increases in flood damage.[5] Human behaviour often reduces the resilience of the land and water resources in the system.

Floodplains are attractive places for human settlement because of their economic potential: they are often fertile agricultural areas, and the rivers provide excellent transport routes. Yet the ongoing occupation of floodplains has increased flood risk. In addition, increased investment in traditional flood management options – such as storing run-off, increasing the river's capacity and separating the river and population by dykes – have affected the hydrological, ecological, economic and social functioning of the river basin.

Because traditional flood control has essentially been problem-driven, the effects of interventions on other areas in the river basin (upstream or downstream) or on other components of the water system (land use, drinking water services, ecological services) have largely been neglected. In addition, the construction of "visible" structural flood protection measures has reduced public awareness of flood risk.

An approach is needed that (a) maximizes the net benefits from floodplains – i.e. the overall benefits of using the floodplain for development, reduced by the investment in flood defences and flood losses after implementing those measures[6] – and (b) minimizes loss of life. Such a holistic approach therefore needs to integrate land and water resources management, raise the awareness of flood risk, and needs to reduce vulnerability to floods, while recognizing the dynamics of the system as a whole. This of course implies an integrated river basin approach that takes account of natural geographical and hydrological boundaries rather than administrative and political ones.

Since floods do not respect any kind of border, riparian countries should engage in joint flood management in order to broaden the knowledge and information base, which in itself will increase their strategic options and allow for better and more cost-effective solutions. The UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) provides an important framework for transboundary cooperation. It obliges Parties to prevent, control and reduce transboundary impact. Since the Convention came into force, these basic obligations have been elaborated in more detail and expanded in a number of guidelines, which have in turn been combined with capacity-building activities.

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5 See also Bates, B.C. et al. (eds.), 2008. Climate Change and Water. Technical Paper of the Intergovernmental Panel on Climate Change, Geneva, IPCC secretariat.

6 WMO, 2004. Integrated Flood Management Concept Paper.

The Workshop on Transboundary Flood Risk Management (Geneva, 22–23 April 2009) organized jointly by UNECE, the Governments of Germany and the Netherlands as well as WMO facilitated an exchange of experiences and knowledge between EU and non-EU countries. These allowed participants to draw lessons for further international cooperation in the field of flood management. The workshop's objectives were:

- To exchange experiences and to support the transfer of results from research projects and other recent activities concerning flood management in the EU to non-EU countries.
- To provide a platform for the exchange of positive and negative experiences and of lessons learned by Parties that have developed flood risk management plans, taking into account the transboundary context, and those that are currently developing or planning to develop such programmes;
- To analyse in-depth flood management problems in a limited number of transboundary basins in the UNECE region, and to provide recommendations for improving transboundary cooperation regarding flood risk management in these basins.

Experts from Armenia, Azerbaijan, Belarus, Czech Republic, Finland, Georgia, Germany, Greece, Hungary, the Netherlands, the Republic of Moldova, Serbia, Slovakia, Switzerland, Turkey, Ukraine and Uzbekistan participated in the workshop. They were joined by representatives of the WMO secretariat, the Azerbaijan Geographical Society, ECO-TIRAS, the International Office for Water, Via Donau-Oesterreichische Wasserstrassengesellschaft (Austria's waterway management and development company) and the Joint Research Centre (JRC) of the European Commission (EC).

The workshop included presentations and discussion of 10 case studies from river basins in the UNECE region. The workshop sessions and case studies focused on the different stages of transboundary flood risk management, i.e. joint flood forecasting and warning and exchange of data, joint flood risk management planning and institutional and legal arrangements for cooperation.

The basis for transboundary flood management is laid out in internationally agreed concepts such as integrated flood management, but also international legal frameworks providing rules and regulations such as the Water Convention or the flood-related Directives of the EU. Chapter 1 of the present volume therefore deals with such international frameworks and regulations for coping with floods.

Implementation of these international frameworks is needed at the river basin level. Cooperation usually starts as a first step at the more technical level: through joint flood forecasting, flood warning and exchange of data. Chapter 2 focuses on challenges and possible solutions in this regard.

Cooperation regarding early warning is not sufficient in many cases; effectiveness of flood prevention can only be optimized through joint planning and implementation of flood risk management. This is the central topic of chapter 3.

In the medium and long term, an appropriate and fair institutional and legal framework is necessary to sustain the cooperation. This is described in chapter 4. Conclusions and recommendations follow in chapter 5.

This publication follows the structure of the workshop and includes parts of the discussion paper ("Flood risk management in a transboundary river basin context") prepared beforehand. The current text also reflects the presentations of representatives of countries and international and national organizations.

1. International guidelines and regulations for flood risk management

1 International guidelines and regulations for Flood Risk Management

1.1 Integrated flood risk management

Integrated flood management (IFM) refers to the integration of land and water management in a river basin using a combination of measures. These focus on coping with floods within a framework of integrated water resources management (IWRM) and adopting risk management principles, while at the same time recognizing that floods have beneficial impacts and can never be fully controlled.

Within the overall framework of IWRM, the IFM approach aims to simultaneously preserve ecosystems and their associated biodiversity, to reduce loss of life as a result of flooding, flood vulnerability and risks, and to maximize net benefits from floodplains.

Given its holistic approach, IFM addresses the water cycle as a whole, integrating land and water management. The idea is to adopt the best mix of both structural and non-structural strategies by ensuring a participatory approach and adopting integrated hazard management approaches.

Integrated flood risk management requires adopting a river basin approach to planning that involves many disciplines and stakeholders in efforts to reduce flood vulnerability and risk and to preserve ecosystems. It also seeks to strengthen our adaptive capacity to climate variability and change. It is based on the following principles:

- **River basin management**. Water management should be based on boundaries of the river basin, not on administrative areas or country borders, thus taking into account a river system as a whole, from source to mouth.
- **Solidarity**. Problems should not be shifted to neighbouring countries or regions. Negative effects between upstream and downstream areas should be prevented, and positive effects should be stimulated.
- **Sustainability**. IWRM aims at a combination of economic development, ecological protection and improvement of social welfare and justice. River basin management should start with a cohesive approach in which a broad spectrum of interests, disciplines and policy fields are involved. Different aspects, e.g. water quality, water quantity, groundwater use, land use, economy, ecology and the environment, need to be balanced. In the context of flood management, the principles of sustainable development involve ensuring livelihood and security among different population groups as well as the viability of ecosystems and floodplain functions, including in the long term.
- **Public participation**. Active public involvement in the development and implementation of water management strategies and plans.

Rivers are dynamic systems and society is changing all the time. Integrated flood risk management is hence a cyclic management process (see figure 1). The flood risk management cycle is, for example, described in the Directive on the assessment and management of flood risks (EU Floods

Directive)[7] as well as in the UNECE Guidance on Water and Adaptation to Climate Change. This cyclic process encompasses the following steps:

1 Flood prevention

2 Flood protection

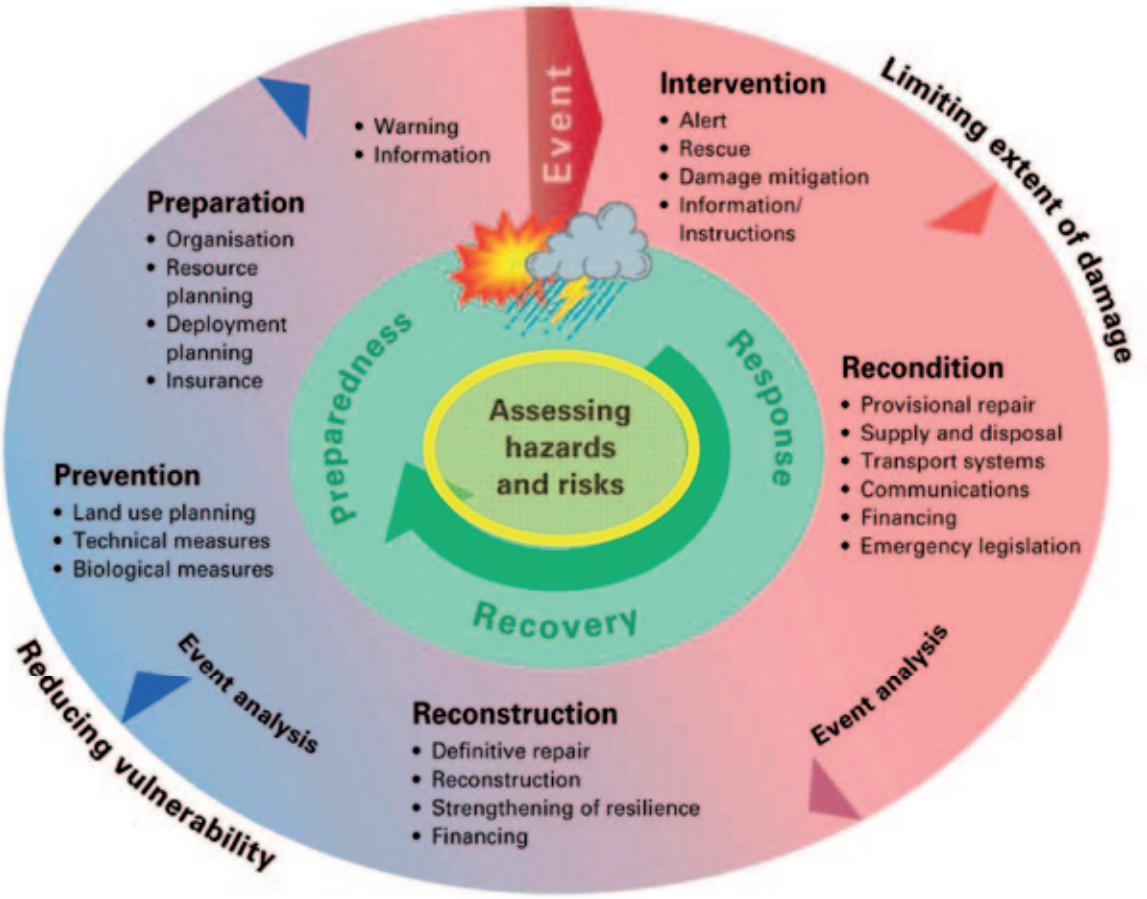
3 Flood preparedness

4 Emergency response

5 Flood damage recovery

For effective integrated flood risk management, all these steps are relevant, although specific local or regional circumstances may require more emphasis on one particular step.

Figure 1: The cycle of integrated risk management.



Source: Federal Office for Civil Protection (FOCP). Download and further information: http://www.planat.ch/index.php?userhash=106604770&l=e&navID=5.

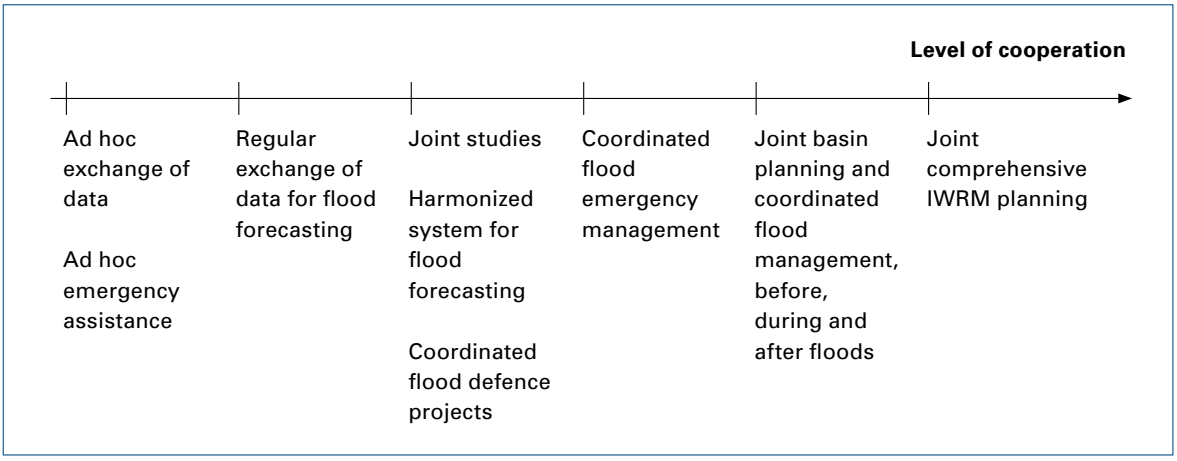
7 Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks.

1.2 The transboundary characteristics of integrated flood risk management

In certain European river basins, transboundary water resources management has a long history (e.g., the Rhine, the Danube and the Iberian river basins). However, transboundary cooperation is not simple and requires concerted efforts from riparian countries. Transboundary flood management is a long process and typically undergoes different stages (see figure 2). Ideally, cooperation moves rapidly to the next stage.

Successful transboundary cooperation depends above all on understanding and respecting the problems and needs of transboundary partners as well as the causes of these problems with respect to natural and social processes. For progress to occur, common goals and agreed strategies are needed, as well as in some cases, compensation mechanisms to balance advantages and burdens. These can be only reached if the partners get to know each other by working frequently together and have shared access to all relevant information, thus creating the necessary level of trust.

Figure 2: The flood management cooperation continuum.



Source: WMO/Global Water Partnership Associated Programme on Flood Management.

Box 1 – Sustainability of flood management strategies: the World Meteorological Organization's work on water, climate and development

Under the banner of "Flood Management Policy and Sustainable Development: recognizing development needs and managing risk", WMO continues to implement its Associated Programme on Flood Management (APFM). APFM is based on the recognition that settling on floodplains has enormous advantages, but past flood management practices have had their shortcomings:

- The emphasis has been on "control" rather than "management"
- Measures for flood control have been ad hoc and stand-alone
- Measures for flood control have been reactive rather than proactive
- The emphasis has been largely on structural measures
- Solutions have been developed in a monodisciplinary manner
- Rivers' morphological behaviour have not been factored in
- Lessons from past failures have rarely been learned

WMO activities support countries in implementing IFM, including its transboundary dimension. IFM aims to minimize loss of life from flooding while maximizing the net benefits derived from floodplains through support of livelihoods and poverty reduction.

WMO provides policy guidance and publishes the Flood Management Tools Series in support of implementing an integrated approach to flood management.[8] Through its joint capacity-building programme with Cap-Net, (an international network for building capacity in IWRM), WMO provides regular training sessions and workshops on flood management policy and urban and community-based flood management. Pilot and field demonstration projects on IFM continue to be implemented to raise the necessary political momentum for change in the sector. The WMO World Hydrological Cycle Observing System (WHYCOS) seeks to improve basic observation activities, strengthen international cooperation and promote the free exchange of data in the field of hydrology. This includes the timely exchange of accurate flood forecasts at the river-basin scale (see www.whycos.org).

In 2009, WMO and more than 20 partners established the Helpdesk for Integrated Flood Management, which provides guidance on flood management policy, strategy and institutional development related to flood issues to countries and river basins wishing to adopt the IFM concept. This entails not only advocacy, policy formulation and implementation components, but also the required capacity-building programmes to support them.

The HelpDesk is a fully demand-driven facility that can be engaged through a simple mechanism provided at the website below.

For more information, visit www.floodmanagement.info or contact floodmanagement@wmo.int.

1.3 The Water Convention and transboundary flood management

In the UNECE region – which extends from Central Asia to North America – more than 150 rivers are transboundary. The UNECE Water Convention, adopted in 1992 and in force since 1996, aims to prevent, control and reduce transboundary impacts. These encompass any significant adverse effect on human health and safety, flora, fauna, soil, air, water, climate, landscape and historical monuments or other physical structures or the interaction among these factors, as well as effects on the cultural heritage or socio-economic conditions. The Convention requires that transboundary waters are used in a reasonable and equitable way. It also supports ecologically sound and rational water management, the conservation of water resources and the environmental protection as well as the conservation and, where necessary, the restoration of ecosystems.

Although the Water Convention does not address floods in detail, it contains many provisions relevant for the management of transboundary floods. It obliges Parties to prevent, control and reduce transboundary impacts, including those resulting from floods or from unilaterally decided flood protection measures such as dams.

The Convention requires that Parties cooperate in research and development and that they exchange information on water quantity and quality. Parties are required to establish joint monitoring programmes to monitor the condition of transboundary waters, including floods, as well as to establish warning and alarm procedures. Parties should also cooperate on the basis of equality and reciprocity by concluding bilateral and multilateral agreements. They should establish joint bodies to provide forums for discussing planned flood prevention measures and agreeing on possible joint measures. Finally, Parties should assist each other – for example, in case of floods.

[8] See: http://www.apfm.info/ifm_tools.htm. For the tool, "Formulating a Basin Flood Management Plan", see: http://www.apfm.info/pdf/ifm_tools/Tools_Basin_Flood_Management_Plan.pdf.

The health aspects of floods come under the scope of the Convention's 1999 Protocol on Water and Health. The Protocol aims to prevent, control and reduce significant adverse effects on human health caused directly or indirectly by the condition, or changes in, the quantity or quality of all types of water.

Since the Convention came into force, these basic obligations have been elaborated in and expanded in a number of guidelines, which have been in turn combined with capacity-building activities. In 2000, the Guidelines on Sustainable Flood Prevention[9] drafted by a Task Force on Flood Prevention and Protection with Germany as lead country, were adopted at the second session of the Meeting of the Parties. The Guidelines cover (a) basic principles, policies and strategies for transboundary flood management, (b) tasks of joint bodies, (c) the provision of information, (d) mutual assistance and public awareness, and (e) education and training. They recommend that joint bodies (a) develop long-term flood prevention and protection strategies as well as action plans, (b) draw up an inventory of structural and non-structural measures and (c) help countries cooperate in establishing the water balance for the entire catchment area. The Guidelines also include good practices, inter alia on retention of water in the soil, proper land-use, zoning and risk assessment, early warning and forecast systems, and awareness-raising and planning. Finally, the Guidelines address the health impacts of floods.

The UNECE Guidelines influenced the EU Best Practices Document on Flood Prevention, Protection and Mitigation, published in 2003 and the Directive 2007/60/EC on the assessment and management of flood risks. In fact, the EU Best Practices Document explicitly states itself to be an update of the UNECE Guidelines.

In 2006, the UNECE Guidelines on Sustainable Flood Prevention were complemented by Model Provisions on Transboundary Flood Management (see annex I). The Model Provisions were jointly drafted by the Convention's Task Force on Flood Prevention and Protection and the Legal Board to strengthen the legal framework for cooperation on transboundary flood management. The Model Provisions are meant to be used as part of either a general bilateral or multilateral normative instrument on transboundary water issues or a flood-specific one involving riparian States. The goals are to address transboundary flood prevention, protection and mitigation and to enhance preparedness thereto.

The Model Provisions also provide a commentary to each provision. They stipulate that Parties take all appropriate measures to prevent, mitigate and protect against flood risks in transboundary river basins and refrain from taking measures that may result in a transfer of flood risk to another riparian country. They also provide for the exchange of information between riparian Parties and for the setting up and operation of coordinated or joint communication, warning and alarm systems, to obtain and transmit information. Riparian Parties should develop long-term flood management strategies and measures for transboundary river basins, including:

- Exchange of hydrological and meteorological data, monitoring/data, collection, and development of a forecasting model covering the whole river basin, or linking Parties' respective forecasting models
- Preparation of surveys, studies (including cost-benefit or cost-effectiveness analysis), floodplain maps, flood risk assessments and flood risk maps, taking due account of local knowledge and the exchange of relevant national data and documentation
- Development of a comprehensive flood action plan addressing prevention, protection, preparedness and response, and providing for common objectives, joint action, contingency

[9] See document MP.WAT/2000/7, available online at: http://www.unece.org/env/water/publications/documents/guidelinesfloode.pdf.

plans, information policy, floodplain management and, where appropriate, flood control works and financing mechanisms

- Awareness-raising, access to information, public participation and access to justice.

The Model Provisions also recommend that Parties incorporate environmental requirements into their flood protection strategies and restore the natural functioning of watercourses. Finally, Parties should consult each other if they wish to undertake a project likely to significantly alter the water flow.

Moreover, in order to support transboundary flood management, several capacity-building activities were developed under the Convention; one such activity was the Seminar on flood prevention, protection and mitigation (Berlin, 21–22 June 2004)[10].

Implementation of the Convention, however, is still weak in certain areas. Establishing a mechanism for compliance and enforcement, which in contrast to other UNECE environmental conventions does not at present exist for the Water Convention, would be useful particularly in terms of reinforcing the political commitment to cooperation.

Currently, the National Policy Dialogue (NPD) in Ukraine implemented in the framework of the EU Water Initiative includes flood management as one of the topics related to adaptation to climate change in water management. The objective is to assist Ukraine with specifying policy measures as well as institutional and managerial tasks related to flood issues.

Box 2 – The Guidance on Water and Adaptation to Climate Change

The UNECE Guidance on Water and Adaptation to Climate Change provides a general road map for policymakers and water managers on how to adapt to climate change. It gives a step-by-step description of how to assess the impacts of climate change and how to develop policy, strategies and operational responses. It addresses water scarcity and floods as well as health impacts, with a special focus on the transboundary context.

The Guidance outlines the key steps to developing an adaptation strategy, namely:

- Establishing the policy, legal and institutional framework
- Understanding vulnerability: defining information needs, elaborating scenarios and models, and assessing vulnerability
- Developing and implementing of an adaptation strategy
- Evaluation.

The Guidance is avalable at http://www.unece.org/env/water/mop5/mop5_docs.htm.

[10] See: http://www.unece.org/env/water/meetings/flood/seminar.htm.

1.4 European Union Directive on the assessment and management of flood risks[11]

EU Directive 2007/60/EC on the assessment and management of flood risks (EU Floods Directive) entered into force on 26 November 2007. It was developed to establish a framework for assessment and management of flood risks, with the aim of reducing adverse consequences for human health, the environment, cultural heritage and economic activity associated with floods in the EU.

The Directive requires EU Member States: (a) to assess whether watercourses and coastlines are at risk from flooding; (b) to map the flood extent, the assets and the populations at risk in these areas; and (c) to take adequate and coordinated measures to reduce the flood risk. In addition, this Directive reinforces the public's right to access this information and to have a say in the planning process.

The Directive requires Member States to first carry out a preliminary assessment by 2011 to identify the river basins and associated coastal areas at risk of flooding. For such zones, they then need to draw up flood risk maps by 2013 and by 2015 to establish flood risk management plans focused on prevention, protection and preparedness. The Directive applies to both inland and coastal waters, across the whole territory of the EU.

The Directive is to be implemented in coordination with the EU Water Framework Directive, notably by coordinating flood risk management plans and river basin management plans, but also by coordinating the public participation procedures for preparation of these plans. All assessments, maps and plans prepared are to be made available to the public.

Member States must furthermore coordinate their flood risk management practices in transboundary river basins, including with third counties, and should not undertake measures that would "significantly increase flood risks" in neighbouring countries[12], unless these measures have been coordinated and an agreed solution has been found. Member States should in take into consideration long-term developments, including climate change, as well as the sustainable land use practices in the flood risk management cycle addressed in the Directive.

Floods are defined as "the temporary covering by water of land not normally covered by water including floods from rivers, mountain torrents, Mediterranean ephemeral water courses, floods from the sea in coastal areas". Particular cases such as pluvial floods, floods caused by groundwater and reservoir dam breaks are also included; floods from sewerage systems are excluded.

Flood risk is defined as "a combination of probability of a flood event and of the potential adverse consequences for human health, environment, cultural heritage and economic activity associated with a flood event". Flood risk and hazard mapping will be performed between 2011 and 2015, including the use of flood scenarios.

The Directive stipulates that a preliminary flood risk assessment be made by 22 December 2011 for each river basin district, or unit of management, or the portion of an international river basin district lying within their territory. This should be based on available or readily derivable information, in particular about the impacts of climate change on the occurrence of floods.

[11] See also: http://ec.europa.eu/environment/water/flood_risk/index.htm.

[12] The Directive states that "In the interests of solidarity, flood risk management plans established in one Member State shall not include measures which, by their extent and impact, significantly increase flood risks upstream or downstream of other countries in the same river basin or sub-basin unless these measures have been coordinated and an agreed solution has been found among the Member States concerned".

The preliminary flood risk assessment shall include at least:

- Maps of the river basin district at the appropriate scale (borders of river basins, sub-basins, topography, land use, etc.).
- A description of floods which (a) have occurred in the past, (b) had significant adverse impacts on human health, environment, cultural heritage, economic activity, and (c) for which the likelihood of similar future events is still relevant (including their flood extent and conveyance routes/assessment of adverse impacts).
- Depending on the specific needs of the Member State, an assessment of potential adverse consequences of future floods, taking into account as far as possible other issues. These could include topography, watercourses and their hydrological/geo-morphological characteristics, floodplains as natural retention areas, effectiveness of existing man-made flood defence infrastructures, populated areas, areas of economic activity and long-term developments (including the impacts of climate change on the occurrence of floods).

Flood risk management plans are required from Member States by 22 December 2015, on the basis of the maps from the preliminary flood risk assessment, at the river-basin district level, or other unit of management. The Directive further implies that Member States establish appropriate objectives for the management of flood risks, focusing on the reduction of potential adverse consequences of flooding for human health, environment, cultural heritage and economic activity, and on non-structural initiatives and/or on reduction of the likelihood of flooding.

Flood risk management plans should take into account relevant aspects (e.g. costs, benefits, flood extent, flood conveyance routes, areas that have the potential to retain floodwater-natural floodplains, environmental objectives, soil and water management, spatial planning, land use, nature conservation, navigation and port infrastructure).

Furthermore, flood risk management plans should address all aspects of flood risk management, focusing on prevention, protection and preparedness, including flood forecasts and early warning systems. They should also take into account the characteristics of the particular river basin or sub-basin.

Food risk management plans may also include the promotion of sustainable land use practices, the improvement of water retention as well as the controlled flooding of certain areas in the case of a flood event.

According to EU legislation, all steps towards proper flood risk management have to be repeated every six years. The Floods Directive, however, does not have strong requirements regarding restoration after flooding.

1.5 European knowledge circles on flood mapping and flood forecasting

Knowledge of hazards and risks, in particular their spatial distribution, is at the core of effective flood risk management planning. Two European initiatives focus on knowledge and information concerning flood risks: the European exchange circle on flood mapping (EXCIMAP) and the European exchange circle on flood forecasting (EXCIFF).

1.5.1 European exchange circle on flood mapping[13]

In 2005, the EU Water Directors, recognizing a common European need to carry out flood mapping and to exchange the experiences and expertise about flood mapping, in particular in relation to the implementation of the EU Floods Directive, decided to gather existing experiences and expertise into a European exchange circle on flood mapping (EXCIMAP).

EXCIMAP forms a knowledge base; it is not a set of guidelines. Under EXCIMAP, a variety of different hazard and risk maps have been collected and compared. The objectives were:

- To review the current practices in flood mapping in Europe
- To identify the knowledge and good practices that can be shared
- To write a publication with good practices on flood mapping.

EXCIMAP work has resulted in two products:

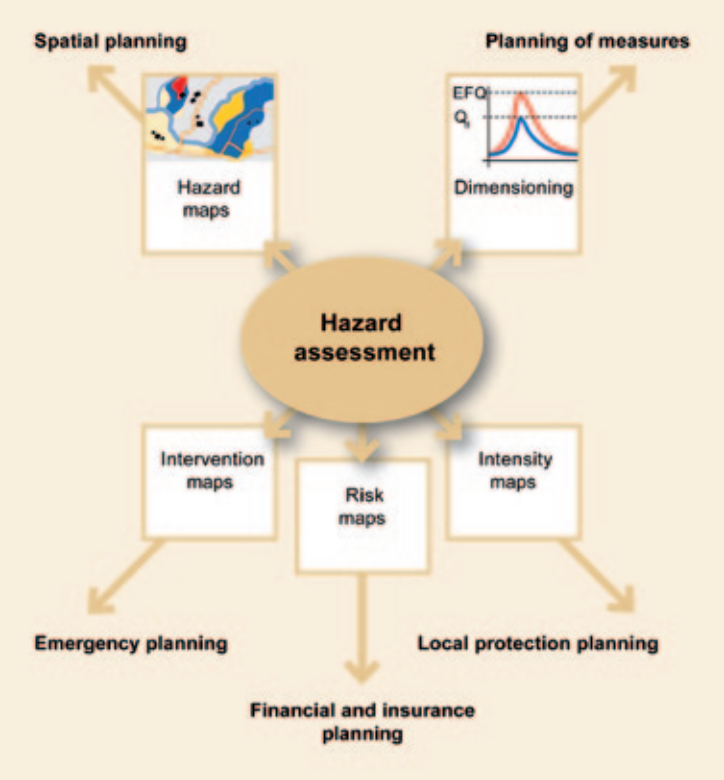
- The *Handbook on good practices for flood mapping in Europe* (2007), containing information on the use of flood maps, flood hazard maps and flood risk maps, the process of flood mapping and the dissemination of flood maps.
- An *Atlas of flood maps* (2007), containing examples of national practices (19 European countries, Japan and United States of America) and chapters on transboundary flood mapping, flood maps for insurance and emergency maps.

Different types of maps are needed for different aspects of flood management (see figure 3), such as land use planning, emergency management, insurance and raising public awareness. Hazard and risk maps provide information on the spatial distribution of the driving factors for the damage or the risk. The maps should be developed in a way that it is understood by the different stakeholders, to help them choose the most appropriate measures. This means that depending on the

[13] See: http://ec.europa.eu/environment/water/flood_risk/flood_atlas/index.htm.

end-user and the use and aim of the map, different types of maps might be needed. They all fulfil the requirements of the EU Floods Directive, but their development depends on the given problem and aims, as well as the resources available.

Figure 3: Hazard assessment: basic types of maps for hazard-relevant activities.



Source: «The floods of 2005 in Switzerland – Synthesis report on the event analysis». Federal Department for the Environment, Transport, Energy and Communications DETEC (Ed.), Report DIV-7529-E, Bern, 2008. www.bafu.admin.ch.

Flood hazard maps collected by EXCIMAP show different parameters, e.g. flooding depth, flow velocity, flood wave propagation with their probability and extend, either by individual maps or as lumped parameter maps with hazard zones. While the flood maps including different parameters provide basic information, the hazard zone maps are more directly oriented to application. They can be the basis for land use planning or insurance.

Flood hazard maps should be developed for different scenarios: floods of high probability (where appropriate), medium probability (likely return period ≥ 100 years) and low probability. For each of the scenarios, it is recommended that the maps contain the flood extent, the water depths or water level, and the flow velocity or the relevant water flow (where appropriate).

Vulnerability maps, often also called risk maps, show the assets at risk. The content can vary even more than in hazard maps. They can show the persons exposed to different degrees of risk, pure monetary damage, sensitive spots and environmental hazards. They may include vulnerability of the populations concerned. Vulnerability maps and hazard maps lead to emergency and flood defence planning, which again can be presented in separate maps. The different elements can be combined in interactive maps.

Flood risk maps should show the potential adverse consequences associated with the flood scenarios and expressed in terms of:

- The number of inhabitants potentially affected
- The type of economic activity in the area potentially affected
- Installations that might cause accidental pollution
- Other information that the Member State considers useful.

In reality, however, the ability to produce flood risk maps differs significantly between countries in the UNECE region due to differences in knowledge and the availability of technical infrastructure for data gathering and exchange, modelling and mapping, and financial resources. Producing flood risk maps is expensive and depends on availability of data. Switzerland estimated the costs for flood risk mapping to be approximately € 2,000/km^2.

1.5.2 European exchange circle on flood forecasting[14]

Exchange of flood forecasting experience in Europe generally happens for example through bilateral contacts or multilateral bodies such as international river commissions (e.g. those for the Rhine, the Elbe, the Oder, the Danube). Initiatives by International Organizations also promote exchange of experience, such as the WMO Regional Association VI (Europe) – Working Group Hydrology, Flood Forecasting, the European Flood Alert System (EFAS) and the CRUE ERA-NET project, which aims to introduce a structure into the area of European flood research by improving coordination between national programmes.

Between 2004 and 2007, the European exchange circle on flood forecasting (EXCIFF) was established to facilitate the exchange of knowledge and experience in the field of flood forecasting, in the areas of:

- Flood monitoring and detection practices
- Flood forecasting procedures and organization
- Information for triggering flood warnings.

A review of current flood forecasting practices in Europe has been carried out in the different areas by EXCIFF. In addition, the main information needs for these different areas have been assessed, resulting in an overview of data and information requirements for various types and aspects of forecasting. The assessment resulted in a number of priority actions, such as training of experts, the production of a report ("Good Practice for Delivering Flood-Related Information to the General Public") and an exchange of experience related to how to organize flood forecasting.

1.6 European Flood Alert System

Following the disastrous floods in the Elbe and Danube basins in August 2002, the European Commission (EC) initiated the development and testing of the European Flood Alert System (EFAS), aimed at early flood warning and at complementing existing national systems. Developed and tested at the EC Joint Research Centre (JRC), EFAS is capable of providing medium-range flood simulations across the EU with a lead time (i.e. the time between the detection and the arrival of the flood) of 3–10 days. Since its establishment, EFAS has successfully provided early warnings – especially 3–6 days before a flood. Examples include: (a) the August 2005 flood in the Northern

[14] See also: http://exciff.jrc.ec.europa.eu and http://floods.jrc.ec.europa.eu.

Alps; (b) the Elbe and Danube snowmelt flooding in March/April 2006; (c) several flood warnings for Romanian rivers, including in August 2008; and (d) the Po flooding in April 2009. In several of these cases, civil protection activities were able to start earlier thanks to the early EFAS warning.

Twice daily, EFAS collects about 70 different numerical weather forecasts from the European Centre for Medium Range Weather Forecasts (ECMWF), Deutscher WetterDienst (DWD) and European Consortium on Meteorology-Limited Area Ensemble Prediction System (COSMO-LEPS), as well as near-real time weather and river-discharge observations from several European providers. These are input into a hydrological modelling system (LISFLOOD) that then produces 70 flood forecasts. Statistical comparison with historical floods enables EFAS to determine whether critical flood alert thresholds are potentially exceeded in the forecast time window. In that case, an active flood-warning e-mail is sent to the member national hydrological services (NHS) that a river flood is likely to happen. NHS can follow the detailed results and access an overview of all alerts on a protected web server.

The benefits of EFAS are two-fold. First, it aims to provide the EC with useful information for the preparation and management of aid before and during a flood crisis, though its Community Mechanism on Civil Protection coordinated via the Monitoring and Information Centre (MIC) in Brussels. Second, the network of 25 national and/or regional hydrological services benefit from additional medium-range flood information that might contribute to increased preparedness in an upcoming flood event.

Membership to EFAS is free of charge and is open to national and regional hydrological services that have a role in the operational national/regional flood warning upon the signing of a simple memorandum of understanding clarifying roles and liabilities, without obligations for a NHS. At present, EFAS covers Europe as far east as 30° East Longitude (including Finland, the Baltic States and the Republic of Moldova). Further extensions could be envisaged if there was a strong demand from the countries involved.

As an essential part of EFAS, the exchange of near-real time river flow data, is established with the hydrological services in close collaboration with the Global Runoff Data Centre (GRDC) in

Koblenz, Germany, an initiative of WMO. These data enable better forecasting, but also essential verification of forecasts for further improvements of the system. Preparations for an operational phase of EFAS have started. This is planned for around 2011 and beyond.

1.7 European Union White Paper – Adapting to Climate Change: Towards a European Framework for Action[15]

The EU White Paper "Adapting to Climate Change: Towards a European Framework for Action" was elaborated to improve the ability of the EU to deal with the impact of climate change by maximizing the effectiveness of national efforts through an integrated and coordinated approach at the EU level. The White Paper aims to establish a cross-cutting policy framework following a phased approach that allows for a gradual uptake of actions depending on severity of impacts, uncertainties and decision-making cycles.

The EU White Paper considers water to be a cross-cutting issue. Several already available EU water-related Directives (e.g. the Water Framework Directive, the Floods Directive and the Marine Strategy Directive) provide EU countries with a good basis for preparing to cope with climate change impacts. Very relevant are also the 2007 Communication on water scarcity and droughts[16] and its 2008 follow-up report, the White Paper and the guidance document ("River basin manage-

[15] Available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0147:FIN:EN:PDF. See also: http://ec.europa.eu/environment/climat/adaptation/index_en.htm.

[16] Communication from the Commission to the European Parliament and the Council – Addressing the challenge of water scarcity and droughts in the European Union. COM(2007) 414 final.

ment in a changing climate") developed under the Common Implementation Strategy of the EU Water Framework Directive.

Box 3 – Main pillars of the European Union White Paper on adaptation to climate change

1 **Building a stronger knowledge base**
- Information availability still differs considerably across regions
- Europe-wide monitoring programmes and spatially detailed information, including climate change impact scenarios, are needed
- Better understanding of socio-economic aspects, costs and benefits of different adaptation options, and information on good practices are also required.

2 **Taking climate change impacts into consideration in key EU policies**
- Adaptation needs to be mainstreamed into EU policies where climate risk and adaptation measures will need to be considered, in order to reduce in the long term the vulnerability of the sectors (e.g. agriculture, forests, biodiversity and protection of ecosystems (including water), fisheries, infrastructure (energy, transport), water and health). This exercise must be carefully prepared and be based on solid scientific and economic analysis. For each policy area, there should be a review of how policies could be refocused or amended to facilitate adaptation.

3 **Financing – combining different policy measures to the best effect**
- Financial constraints are one of the main barriers to adaptation
- Climate change is one of the priorities for the current multi-annual financial framework in the EU (2007–2013)
- There is a need to further examine the potential use of innovative funding measures for adaptation and to explore the potential for insurance and other financial products to complement adaptation measures and to function as risk-sharing instruments

4 **Supporting wider international efforts on adaptation**
- EU external cooperation should make a significant contribution to promoting adaptation in partner countries, particularly neighbouring countries
- Bilateral and regional financial assistance programmes will aim to integrate adaptation considerations into all relevant sectors.

5 **Working in partnership with national, regional and local authorities**
- Encourage the further development of national and regional adaptation strategies, with a view to considering mandatory adaptation strategies from 2012
- Support cooperation on adaptation and with a view to taking the Framework forward.

Altogether, this is meant to lead to elaboration of a comprehensive adaptation strategy for the EU. Implementation should commence in 2012.

1.8 Conclusions

There are a variety of policy and legal frameworks as well as tools for improving flood risk management at the transboundary level. These frameworks offer a sound basis for the implementation of flood risk management within the concept of IWRM, in all countries of the UNECE region. Non-EU countries should also take advantage of policies and tools developed at the EU level.

International organizations also play an important role for transboundary flood management. In particular in the UNECE region, there is a complementarity of the work of WMO, focusing on technical issues, with that of the Water Convention, concentrating on supporting processes that foster cooperation at the political level and the conclusion of agreements. This makes joint work effective, bringing together the comparative advantages of both organizations.

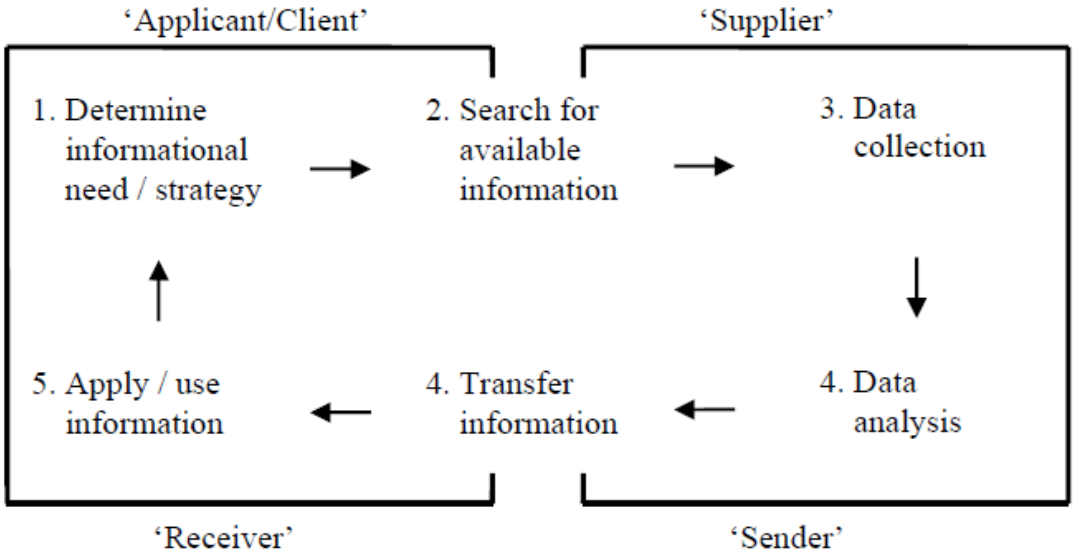
2. Joint flood forecasting, flood warning and exchange of data

2 Joint flood forecasting, flood warning and exchange of data

2.1 Information gathering and information exchange in integrated flood risk management

For effective and efficient flood risk management, it is essential to have in-depth knowledge of the functioning of the water system and the prevailing hazards and risks. Thorough knowledge forms the core of the flood risk management cycle. For every element, from prevention to recovery, reliable information is needed in order to develop the best mix of strategies. The role of information in flood risk management is illustrated in figure 4.

Figure 4: Information cycle and information transfer



Source: NeWater, 2005. Transboundary river basin management – state-of-the-art review on transboundary regimes and information management in the context of adaptive management

Decision-making in integrated flood risk management requires up-to-date, reliable and complete information on hydrological aspects, flood characteristics and the impact assessment of the whole river basin.

Information about the water system should include all relevant meteorological and hydrological parameters, including the type of flooding, probability, intensity (e.g. flooding depth, flow velocity) and extent of impact. An understanding of the river basin and floods can be achieved by analysing and assessing the hydrological aspects of the basin and of past events. The knowledge base should also comprise parameters of ecosystems and their services as well as an understanding of the role of floodplains for the economy.

It is recommended that countries work together to create a comparable knowledge base for their joint analysis and planning, for instance under the responsibility of a joint body such as an inter-

national river commission. A good example in this regard is the Commission for the Hydrology of the Rhine Basin.

Box 4 – Communication of emergency plans for dams to the population: the example of the Ebro River basin

Floods can also occur due to dam failures. Spain ranks fifth worldwide in terms of the number of dams, with more under construction. Dam emergency plans and their communication to the population are essential in the Ebro River basin. A survey of the population revealed that dams are perceived as something positive, not as a risk or danger. People generally assume that a dam will not break, and this is even true of the responsible government agencies. However, a dam emergency plan is automatically supposed to exist, even if no specific information has reached the population. A communication plan is considered as an additional action that provides security. Spanish authorities are using different communication channels, e.g. leaflets, press and radio, meetings and an interactive CD that is being sent to every household. Experience in Spain has shown that a communication plan must be clear, brief and reach the entire population. It should be designed by professionals in the communication field.

Early warning systems and flood forecasting systems are essential for flood preparedness. Often the emphasis of data collection and information transfer is on early warning. However, information exchange is also essential for flood prevention strategies in the sphere of integrated land and water management by, inter alia, creating space for the river, adapting land use (planning) and setting standards. The same applies for the planning of protection measures such as the realization (or removal) of dams, weirs and bypass channels.

Information exchange should occur at the transboundary level. Joint monitoring programmes enhance the options for information exchange.

Public awareness and preparedness for flood events are also important for reducing vulnerability to floods. No matter how good and reliable the information on floods is, without proper communication to the public, the objective of reducing the vulnerability will not be achieved. It is essential that people recognize that flooding is part of their environment. Communities must be aware that they are at risk, which means that they know about flooding and take it into account appropriately when acting. High-quality information is the basis for preparation issues such as the design of flood-proofing, contingency planning, etc.

2.2 Flood forecasting and information transfer

Timely and reliable flood warning, flood forecasting and information are prerequisites for the successful mitigation of flood damage. Risks originating from floods, dam failures and ice hazards may be reduced by:

- Free and unrestricted provision and transfer of meteorological and hydrological data and products
- Informing the downstream areas likely to be affected by floods, critical water levels or ice drifts without delay
- Providing forecasts of water levels, run-off and ice hazards.

Diverse objectives and uses require different types of data and information. As integrated flood risk management aims at a mix of strategies, from prevention to recovery, a large variety of information may be needed. The first step in defining the type, frequencies, parameters, etc., for data collection is to draw up management objectives and list potential strategies for the river basin as a whole. Because the river and flood characteristics may differ from location to location, transboundary cooperation is necessary to take this first step and to develop monitoring and information systems that are useful throughout the entire river basin.

2.3 Case descriptions regarding joint flood forecasting, flood warning and exchange of data

Four cases were presented and discussed:

- Rivers in Transcarpathia (Ukraine)
- The Meriç River, also known as Maritsa (Bulgaria) and Evros (Greece)
- Flood risk management in Greece
- Central Asia

2.3.1 Rivers in Transcarpathia[17]

The Transcarpathian region has a dense network of rivers. The main ones are the Tisza, the Borzhava, the Latoritsa and the Uzh. The Tisza River basin is the largest. The upper (Transcarpathian) part of the Tisza basin is shared by Ukraine, Romania, Slovakia and Hungary. Transcarpathia is predominantly mountainous. Consequently, the area of productive land is relatively small, and settlements, economic activities and infrastructure are concentrated in the river valleys. In these areas, the vulnerability to flooding is high, in part due to anthropogenic pressures on the basin.

Most of the rivers in Ukraine are transboundary. There have been disastrous floods every 10–15 years. Floods of more than 25,000 m^3/sec have caused great damage to agricultural areas. For example, from 23 to 28 July 2008, 56 districts and towns of six oblasts in the Subcarpathian region were catastrophically flooded. Nearly 45,000 buildings in 1,019 settlements were flooded, leading to some 150,000 people being affected. A flood of the same extent was experienced in western Ukraine 40 years earlier, but such great damage had never before been observed.

The flood problems in the Transcarpathian region appear to be caused by deforestation and land use changes, in particular intensive economic land use and settlements in the floodplain aggravated by climate change. Storage reservoirs would be one possible option for reducing floods, but maintenance and operation require high-quality and frequent information on flood waves and river morphology. In Ukraine, maintenance of structural prevention measures is difficult, expensive and therefore sometimes inadequate, which significantly complicates flood prevention and flood protection measures.

Ukraine, with the help of other countries such as Sweden, the United States of America and Romania, has made some efforts to improve its national flood management system. More than 600 pumping stations have been installed in connection with reservoirs; these have been able to prevent floods and distribute water to downstream areas during the year. A system to respond to disasters

[17] Based on a presentation by Mr. Babich, State Water Committee, Ukraine, and the discussion following.

has been set up, and includes State, regional and local administrative levels. Dykes and river banks have been reinforced after major floods, inter alia, by using biological bank protection.

Ukraine has also established an automatic flood forecasting system that has proved very cost-effective. It includes:

- Total automatization of regulatory hydrometeorological observation network
- Creation of digital elevation maps with scales of 1:10,000 and 1:5,000 on a GIS platform
- Development of modelling technologies and forecasting of flood hydrographs and zones of inundation
- Integration of meteorological radar data and satellite images into the forecasting and modelling process
- Creation of a flood emergency warning system.

Ukraine, Romania, Hungary and Slovakia have signed agreements on cooperation in transboundary waters. These focus on notification of planned interventions, prevention from adverse effects and information-sharing. Ukraine, for example, is using a model developed by Slovakia for the Tisza, and supplies Slovakia with data. In the Tisza basin, an online transboundary forecasting system has been installed. The Ukrainian system was realized with financial support from Hungary and other sources. The system is still being improved.

Regarding cooperation with the Republic of Moldova, there are still several difficulties; in particular, the detail of information exchange on river discharges of transboundary rivers between the two countries needs improvement. In addition, improvement of information sharing could help both countries to better deal with flood events. More human interaction between the two countries, especially between experts dealing with the same problem would help, in particular to improve information-sharing and cooperation on specific issues, especially in the event of emergency situations. The establishment of a river basin commission would provide a venue for improving international cooperation on transboundary flood risk management.

2.3.2 Meriç River, also known as Maritsa (Bulgaria) and Evros (Greece)[18]

The Meriç (Maritsa/Evros) is shared by Bulgaria, Turkey and Greece, and is the second largest transboundary basin in South-Eastern Europe. The Meriç has a total length of 550 km and a catchment area of 39,000 km^2. The river originates in Bulgaria and flows through Turkey, where it forms the boundary with Greece for 203 km. The river flows through Greece before it empties into the Aegean Sea.

The lower Meriç suffers from flooding in the territory of all three countries. In recent years, both the frequency and magnitude of floods has increased. Floods that occurred in 2007–2008 had not been experienced since 1987. The city centre of Edirne, located in Turkey close to the border, is quite vulnerable to flooding. Besides the floods, every year channel capacity is dramatically decreasing due to low flows.

Floods originate in the mountainous regions of the Meriç and its tributaries, on Bulgarian territory. Turkey is dependent on Bulgaria for accurate and timely information regarding flooding danger, due to the lack of sufficient warning time in Turkey.

[18] Based on a presentation by Mr. Sezen, State Hydraulic Works (DSI), Turkey, and the discussion following.

Improvement in measures for flood prevention and reduction of flood impacts can be achieved only through cooperation and the use of common information sources. Until 2003, there was no communication between neighbouring countries about floods. Subsequently, Turkey and Bulgaria started cooperating on data and information transfer and flood forecasting and early warning. The main aim was to enlarge the available response time in Turkey. The State Hydraulic Works (DSI, Turkey) and the National Institute of Meteorology and Hydrology (Bulgaria) established contacts and had several meetings to mitigate Meriç River's flooding problem.

Turkey and Bulgaria developed three joint projects through the EU Cross-Border Cooperation Programme, one for exchange of information and real-time data, and two for flood forecasting and warning. These joint projects are the first common projects in the region on forecasting. The information is shared on a common website, with real-time information from two hydrometric stations. The transboundary forecasting and early warning system will be used as input for local and regional preparedness and emergency response plans.

Additionally, four telemetric hydrometry stations have been established in the Bulgarian part of the Meriç catchments. These stations are recording continuously and supply real-time river data using satellite and GSM[19] communication systems to both countries. The established stations and information system have shown some progress, especially during the 2005 and 2006 floods, but these precautions are not enough.

The Bulgarian part of the Meriç basin has a high potential for improving (structural) prevention measures, with downstream effects in Turkey. The lower Turkish part of the river basin is densely populated and at the same time lacks space for prevention measures.

[19] Global system for mobile communications.

Unfortunately, flood forecasting systems are currently still set up nationally, whereas a joint flood forecasting and early warning system in the Meriç basin is needed. Forecasting of the frequency, magnitude and time of floods, warning the provincial and local authorities and public against an expected flood, and activating national and local preparedness and response plans are among the preventive activities needed in order to reduce flood damage.

Cooperation between all three riparian States appears to be difficult, inter alia due to differences in institutional structures. Communication, especially between politicians, is another challenge. As a first step for cooperation, a hydrological model could be jointly developed. Cooperation at the technical level, however, can only flourish if there is political support.

2.3.3 Flood risk management in Greece[20]

There are five transboundary rivers flowing through northern Greece and two international lakes on the northern borders of the country. Major flood events in these areas are usually caused by intense rainfall combined with snowmelt. They occur mainly in late winter, spring and early summer.

A national general emergency plan ("Xenokratis") was enacted in Greece for the prevention, mitigation and control of natural hazards, including floods. Flood forecasting and warning is carried out in cooperation by the Hellenic National Meteorological Service (HNMS), which is responsible for issuing emergency forecasts and warnings for intense precipitation phenomena, the Hellenic Civil Protection Authority and the respective regional prefectures and municipalities.

In total, there are about 2,000 hydrometeorological stations in Greece, covering the whole country. The weather monitoring system of HNMS consists of about 150 meteorological stations (manned and automatic), nine weather radars, satellite systems and a lightning detection network that consists of eight sensors. The main shortcoming is that various State services have been established and operate sectional networks of limited coverage, and there is not yet a unique administration responsible for organizing and operation of a national network under unified scientific and technical procedures. In addition, as the majority of stations are located at low altitudes, there is a significant lack of measurements from mountainous areas.

2.3.4 Central Asia[21]

Ninety-five per cent of water in Uzbekistan comes from Kyrgyzstan. Most floods are formed in Kyrgyzstan and Tajikistan, sometimes originating from high-altitude lakes. There has been a distinct increase in mud flows. Most flood events happen in April and May. Outbursts of mountain lakes have caused major problems, e.g. in 1988 three glacial lake outburst flows were registered, with about 100 people killed. The Uzbek Ministry for Emergency Situations resettled 1,000 persons from flood-prone areas.

Great importance is attached to warning against floods through monitoring rainfall intensity, snow status and temperature, which enables notification of organizations and population and the protection of buildings and structures against floods.

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[20] Based on the presentation by Ms. Papapetrou, Hellenic National Meteorological Service (HNMS), Greece, and the discussion following.

[21] Based on a presentation by Ms. Dergacheva, Hydrometeorological Research Institute UZHYDROMET (Uzbekistan), and the discussion following.

At the same time, forecasting is not sufficient due to the lack of measurement points. Especially in the upper reaches – the source areas – instrumentation is lacking and expensive to maintain. A hydrological model has been developed, but it is difficult to use due to the lack of data from upstream countries. Lack of data and good hydrometric networks is a serious problem in Central Asia, where 70 per cent of the hydrometric stations have disappeared since the break-up of the Soviet Union.

Communication between Central Asian countries is seen as a major challenge. The Water Convention could be an important framework for addressing flood problems in Central Asia, but its implementation needs improvement and political will is lacking.

The most urgent needs include:

- Collecting and exchanging information between the countries in the subregion
- Sharing the same data by introducing regional databases
- Increasing the efficiency of meteorological equipment
- Developing early warning systems for dangerous hydrometeorological phenomena.

2.4 Conclusions

- **Joint information transfer is a first step to transboundary management.** The development of (small) joint flood risk management projects such as the installation of monitoring and forecasting systems can be a successful first step in transboundary flood management. These provide opportunities to find agreement at an operational level, without the need for complex arrangements and agreements at the (national) political level. In the long term, however, a sound legal basis is needed.
- **Information needs should be defined.** At the basin level, informational needs may vary between regions, depending on various characteristics. Applying a mix of flood risk management strategies requires data and information with different characteristics. In current flood risk management, the main focus appears to be data collection and information transfer, not exploring the final objectives of the information's use. Before setting up forecasting and warning systems, a basin-wide analysis of objectives should be undertaken.
- **Development of a common knowledge base is needed.** Different levels of data availability as well as the lack of meteorological, hydrological and geomorphological data can be obstacles to integrated flood risk management. A common knowledge base and capacity-building in the river basin is required.
- **Systems should be compatible.** In the UNECE region, a great variety of flood information systems is used by various governmental organizations. Despite the needs to transfer data and information, to inform all stakeholders in the river basin and to share knowledge, information systems often operate in isolation, producing data only for internal users. Transboundary agreement on model compatibility and data transfer offers a common basis for assessing flood risk situations in river basins. The challenge of data exchange and information systems is to achieve an undisrupted data and information flow with regard to flood risks in basins. In addition, compatibility of calculation models guarantees that potential strategies and options can be discussed on their merits, without disagreement about their potential effects due to diverging models used.

- **A transition is needed from warning to awareness.** Flood warnings, information and forecasts should also be made available to the public through the media, the Internet or other appropriate means. This should include information about what the public should do. This way, information transfer will contribute to flood risk awareness and thus to the reduction of vulnerability.

3. Joint flood risk management planning and implementation

3 Joint flood risk management planning and implementation

3.1 Elements of flood risk management planning

Flood risk management planning – for example as prescribed in the EU Floods Directive – focuses on the reduction of the potential adverse consequences of flooding for human health, the environment, cultural heritage and economic activity, on non-structural initiatives and on reduction of the likelihood of flooding. Flood risk management plans should aim to maximize the benefits of living in floodplains while minimizing the potential burden. They should focus on prevention, protection and preparedness.

Flood risk management plans need to consider the complete water cycle. They should be integrated with, inter alia, drought management and the management of flood dependent areas such as wetlands and water quality. Furthermore, flood risk management plans need to cover all types of floods, from flash floods, to more regular floods due to snow melt, to ice hazards.

While differentiated flood protection targets will continue to play an important role in flood risk management strategies, including transboundary ones, they must be embedded in the broader considerations of how to deal with residual risks once design flood levels are exceeded. In that case, land uses that are adapted to floods, emergency planning and risk-sharing (i.e. insurance, catastrophe bonds, etc.) should be part of the strategy. Generally, agriculture, ecology and drinking water supply are taken into account in a flood risk management plan, as they are closely linked to the settlements in flood prone areas.

Table: Strategies and options for flood risk management.

Strategy	Option
Reducing flooding	Space for the river Dams and reservoirs Dykes, levees and flood embankments High flow diversion Catchment management Channel improvement
Reducing vulnerability to damage	Floodplain regulation Development and redevelopment policies Design and location of facilities Housing and building codes Flood-proofing Flood forecasting and warning
Mitigating the impacts of flooding	Information and education Disaster preparedness Post-flood recovery Flood insurance
Preserving the natural resources of floodplains	Floodplain zoning and regulation Cyclic floodplain rejuvenation

Source: WMO/GWP, 2004. Integrated flood management. Concept paper.

River basins such as those of the Meriç, the Vuoksi and the Sava show that it is important to take hydropower into account in the planning and that mutual benefits can be achieved (as with the Vuoksi). However, during severe flooding it is often essential to prioritize between various aspects, for example by prioritizing the protection of human health and/or critical infrastructure over hydropower or agriculture. The same counts for the transport and touristic functions of rivers. One example is the Waal River in the Netherlands, where a planning programme has been started to manage flood risks, while at the same time preconditions for intensive navigation are respected, floodplains are being re-naturalized and opportunities for tourism and water recreation are being developed.

Construction of reservoirs and protection dykes are particularly critical in transboundary flood management, as both change the flood characteristics: reservoirs retain and dykes accelerate the flow, thus both may have transboundary impacts. Downstream effects depend on the situation and the characteristics of the flood. Both types of measures might be necessary within IWRM and flood management, but should be planned in consultation with the other riparian countries. In addition, integration of water and land management is necessary. A main aim of the EU Floods Directive is to foster transboundary planning, resulting in action plans such as those for the Rhine, Elbe and Mosel Rivers. The management of the Vuoksi River is also a typical example for transboundary cooperation and planning.

Flood damage can be reduced by avoiding construction of buildings in flood-prone areas and by adapting developments to the risk of flooding. However, apart from high-risk areas, a legitimate concern is if such damage reduction at the cost of (socio-economic) opportunity reduction is in the interest of the affected communities and economies, especially since a river and its floodplains are often very attractive for housing programmes. An integrated management approach may provide opportunities for innovative and beneficial combinations of housing and flood risk management. The same applies, for example, for the combination of creating space for the river and restoring the ecological functioning of floodplains or wetlands.

As different interests may lead to conflicts, they should be addressed transparently in flood risk management plans, on the basis of good faith and reciprocity. All stakeholders should be consulted, and the plans should be kept flexible.

Flood risk management plans also play an important role in the preparedness of flood-prone areas. Based on risk assessments and the various management strategies that will be applied, the plans need to formulate instructions for the public and to the organizations involved in deciding what to do to reduce the vulnerability to flooding and what to do in the event of flooding.

Given the dynamics of rivers, climate and socio-economic systems, a flood risk management plan requires flexibility. Optimizing interventions requires adaptation to change. Moreover, planning needs to be oriented towards a mix of strategies and options. The table gives an overview of this.

3.2 Case descriptions regarding joint flood risk management planning and implementation

Four cases were presented and discussed:

- The Kura River, shared by Armenia, Azerbaijan, Georgia, the Islamic Republic of Iran and Turkey
- The Sava River, shared by Bosnia and Herzegovina, Croatia, Serbia and Slovenia

- The Morava River, shared by Austria, the Czech Republic and Slovakia
- The Vuoksi River, shared by Finland and the Russian Federation

3.2.1 Kura River[22]

The Kura River basin is shared by Armenia, Azerbaijan, Georgia, the Islamic Republic of Iran and Turkey. It originates in Turkey and flows through Armenia, Georgia and Azerbaijan to the Caspian Sea. In Azerbaijan, the Kura is joined by the Araks River, which originates in Turkey and flows through Armenia, the Islamic Republic of Iran and Azerbaijan.

The economy of Azerbaijan is highly dependent on the water sector. The main objectives of its national water management are environmental protection and the rational use of natural resources. Problems regarding water management in Azerbaijan include the lack of clarity regarding the roles of different ministries and institutions involved and the lack of reliable data since Soviet times, due to deterioration of hydrometric networks.

A wide variety of water management projects are being carried out in Azerbaijan. These focus on, inter alia, water supply, wastewater management and flood protection. Different donors are involved in the projects; however, coordination and integration of the various aspects of the water cycle are lacking.

Insufficient knowledge prevents experts from making a comprehensive analysis and assessment of the causes and consequences of flooding. On the one hand, there are not enough hydrometric stations, on the other the riparian countries do not share the data efficiently. While in Azerbaijan improving data quality is the main priority, Georgia has only 15–20 hydrometric stations for the more than 1,000 rivers, a tenth of those that were functioning during Soviet times.

In the Kura basin, transboundary cooperation is problematic. There is a considerable need for a shared knowledge base with respect to the river system and for applicable information about and

experiences with IWRM and integrated flood risk management. The general lack of information, combined with the use of out-of-date technologies, equipment and approaches, makes it very difficult to generate an accurate and useful flood forecast. Due to the absence of data about flood frequency and flood extent over the past 20 years, it is impossible to estimate the influence of global warming. Existing but non-functional flood protection systems should be restored.

The cooperation between Azerbaijan and Turkey is good on the meteorological side, but could be improved on the hydrological side. With the Islamic Republic of Iran, there is a joint commission on the use of water and energy resources that meets once a year. With the Russian Federation, there are informal meetings on the use and preservation of the river. There is no cooperation between Azerbaijan and Armenia.

Suggestions for improving the cooperation between Azerbaijan and Georgia on the Kura include the development of a bilateral agreement with the establishment of a joint body, e.g. a bilateral commission, and plans to initiate data and information exchange arrangements. In the longer term, Georgia and Azerbaijan could pursue cooperation by establishing coordinative arrangements at the technical and operation levels, by developing real-time warning systems and by agreeing on notification procedures.

Other possible next steps for Azerbaijan and the Islamic Republic of Iran might be to carry out a cross-border flood study and to agree on the study results to be used as benchmarks for further action on the principles for flood protection schemes, based on minimizing the impact by both parties.

3.2.2 Sava River[23]

The Sava River originates in Slovenia and flows through Croatia and Bosnia and Herzegovina into Serbia, where it joins the Danube River. It is the second largest tributary of the Danube by basin area (97,713 km^2), and the largest by discharge (average 1,500 m^3/s at the mouth). The course of the Sava is approximately 950 km long, and the basin's altitude ranges from 60 m to 2860 m above sea level.

The Sava serves multiple functions. Floodplains are used as agricultural land, for urbanization and heavy industries. In addition, the river is an important transport route. In the Slovenian part, hydropower plants are present.

In 2004, the Framework Agreement on the Sava River Basin entered into force, and in 2006 the International Sava River Basin Commission[24] was established in order to implement the Framework Agreement. The Commission is the only river basin commission in Europe that deals with navigation (e.g. the establishment of an international regime of navigation on the Sava River and its navigable tributaries) as well as sustainable water management. This includes cooperation on management of the basin's water resources in a sustainable manner, including integrated management of surface and ground water resources, to provide water in sufficient quantity and of appropriate quality for different uses, including the preservation, protection and improvement of aquatic ecosystems. The Commission also seeks to resolve conflicts of interest caused by different uses, and to effectively control the water regime. It works to protect against the detrimental effects of water (e.g. flooding, erosion and ice hazards) and to undertake measures to prevent or limit

[23] Based on a presentation by Ms. Babic-Mladenovic, Institute Jaroslav Cerni, Serbia, and the discussion following.

[24] See: http://www.savacommission.org.

hazards such as floods, ice, droughts and accidents involving substances hazardous to water, as well as to reduce or eliminate related adverse consequences.

Under the Commission, expert groups pursue different tasks not only as support to the secretariat, but also as a link to other experts of the Parties. There is an expert group for hydrological and meteorological issues, a GIS group and a sediment task group that deals with both quantity and quality of sediment. Finally, there is a permanent expert group on flood prevention, which addresses both natural and human-induced phenomena.

The Agreement is a good framework for integrated transboundary flood risk management. Because of its broad scope, many focal points/institutions and a good inter-sectoral coordination and communication at national level are needed.

In addition to the Framework Agreement, a Protocol on flood protection was elaborated in 2009. It follows an integrated planning approach and provides for activities such as:

- Preliminary flood risk assessment
- Preparation of flood maps
- Preparation of flood risk management plan in the Sava basin
- Establishment of the flood forecasting and warning and alarm system in the basin
- Exchange of information significant for sustainable flood protection
- Mutual assistance and implementation of measures and activities of mutual interest, originating from planning documents or the activities above, or from other mutually agreed measures and activities.

Some preliminary flood risk maps have been created covering the whole basin, but funds for maps done with a digital terrain model and GIS are still lacking. An information and forecasting system is available in the basin, but needs to be updated and extended. Lack of financial resources is an obstacle to implementing the joint flood management planning.

The relatively young agreement and Commission in the Sava basin provide a very good basis for transboundary flood risk management. Despite the previously difficult political relations between the countries involved, the Sava Commission can be considered as a success. However, political commitment and support at high political levels remains crucial, for example for launching new projects. There are still numerous challenges to address, such as differences between institutions and the fragmented institutional framework for water and flood management in Bosnia and Herzegovina.

3.2.3 Morava River[25]

The Morava River basin is shared by Austria, the Czech Republic and Slovakia. The source and the largest stretch of the river are in Czech territory. It forms a (small) part of the Czech-Slovak border and of the Slovak-Austrian border. On the latter, the Morava joins the Danube. The main tributary to the Morava is the river Dyje.

[25] Based on a presentation by Ms. Soukalová, Czech Hydrometerological Institute, and the discussion following.

The Morava River is dangerous due to both floods caused by regional rainfall and flash floods, so several flood risk management problems need to be solved at the same time. As an example, damages from the 2006 flood were estimated to be € 35 million. There was much damage to agricultural land due to the flooding, and three people lost their lives. This flood disaster showed that cooperation between Czech and Austrian authorities had to be improved, since 60 per cent of the upper part of the Dyje catchment lies in Austria. In addition, the meteorological and hydrological forecasting and warning systems required improvement.

Bilateral agreements between the three riparian countries concerning forecasting, reporting and warning provide a good basis for information transfer on floods. Data and information for forecasting are being prepared by Czech authorities and are shared with Austria on a common ftp server. River discharge forecasts are provided through a website 48 hours ahead for two Austrian profiles. Flood risk management is dealt with in the bilateral border commissions; there are no plans for establishing a joint river basin commission for the Morava. The practical implementation of information transfer has contributed to improved transboundary cooperation.

The CENTROPE territory (Morava in the Czech Republic, western Slovakia, north-western Hungary and eastern Austria) includes the Morava, Dyje, Danube and Leitha rivers. The following activities are being carried out within the Central European Flood Risk Assessment and Management (CEFRAME) project:

- Review and assessment of the current situation (including natural, hydrological conditions, floodplains and flood defences)
- Flood risk analysis and mapping
- Potential damage maps
- Draft for the harmonization of design criteria and safety regulations along and across border sections; flood management

- Raising awareness and preparedness of the general public
- Development of best practices of use for other regions.

Cooperation can still be improved, for example by interlinking regional and national agencies on sub-basins to facilitate and promote the exchange of source data. At the same time, information should be shared with downstream areas for improved efficiency and lead time of flood forecasting and warning. Methodologies and tools of data collection, processing, forecasting and dissemination should be improved, while the assessment of flood-prone areas and evaluation of flood risk could be harmonized.

3.2.4 Vuoksi River[26]

The Vuoksi River is a transboundary river that flows from Lake Saimaa in south-eastern Finland to Lake Ladoga in the north-western corner of the Russian Federation. The upper part of the Vuoksi (13 km) belongs to Finland and the lower part to the Russian Federation. The Saimaa Lake system is one of the largest in Europe and the largest in Finland; the lake and its ecosystem are quite important. Lake level and outflow rise slowly, resulting in long lead times.

The Vuoksi is the largest transboundary watercourse between Finland and the Russian Federation. The Vuoksi is important for both hydropower and navigation. Most of the area is rural. There are two hydropower plants on both sides of the border. The differences in discharge are rather small: between 220 and 1,170 m^3/s, with a mean of 600 m^3/s. Nevertheless, major flood problems can occur and they are expected to increase due to climate change.

In 1964, Finland and the Soviet Union concluded a bilateral agreement on transboundary waters. In 1973, the Soviet Union proposed regulation of the upstream (Finnish) lakes in order to make the discharge of the Vuoksi River more favourable for hydropower generation. Based on the 1964 legal framework, a Joint Finnish-Russian Commission on the Utilization of Frontier Waters was established. It took until 1991 for the joint commission to accept a bilaterally agreed discharge rule in which both situations of floods and low flow were addressed. Regulation of the discharge is not continuous: it is started under the threat of flood or drought and is kept in close to a natural state the rest of the time. In case of flooding, the discharge can be increased to lower the flood peaks. The bilateral cooperation includes provisions and compensation rules to be applied in such cases. Since there are direct hydroelectric benefits to lowering the Saimaa Lake levels, the case can be regarded as an example of joint IWRM.

The discharge rule stipulates that throughout the year information on water level, precipitation, water equivalent of snow and water level forecast is sent to the Russian side. Real-time forecasts of water level and discharge from some measuring sites both in Finland and in the Russian Federation are available on the Internet. This daily information is important for the Russian hydropower companies and the Russian water and environment authorities.

[26] Based on a presentation by Mr. Ollila, Finnish Environment Institute and the discussion following.


FINLAND
Jänisjoki
Lake Jänisjärvi
Tohmajoki
Lake Pyhäjärvi
Kitee-joki
Lake Saimaa
Hiitolanjoki
Lake Ladoga
Saimaa Canal
Lake Nuijamaanjärvi
Juustilanjoki
Rakkolanjoki
Vuoksi
Vilajoki
Kaltonjoki
Honnijoki
Tervajoki
Vyborg
Urpalanjoki
Vaalimaanjoki
Bay of Vyborg
RUSSIAN FEDERATION
GULF OF FINLAND
60°
30°
St. Petersburg
Kilometres
0 10 20 30 40 50
The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.
UNEP/DEWA/GRID-Europe 2007

In the event of a change in discharge, the Russian side and the power companies are informed. If the discharge is expected to cause damage, the amount of discharge will be agreed on in consultation between the Parties of the Commission. If the damage is caused by the changes of discharge volumes, it will also be discussed and agreed in the Commission and will be compensated by Finland.

Once a year, a working group meeting is held to review the implementation of the rule in the previous year and perspectives for the future. The target of the discharge rule is to achieve as good a result as possible from the point of view of both countries.

The rule has been used seven times for floods and three times for droughts up to the beginning of 2009. These situations have not been very exceptional. The maximum lowering of the flood peak in Lake Saimaa has been 0.3 m and the rising of low water level 0.2 m. The damage prevented in Finland totals about € 10 million, while compensation of decreased electricity production in the Russian Federation is about € 1 million.

There have been no problems in the implementation. Several factors explain this success: the rule that sets the principles and changing of discharges can be started rapidly. Changing discharges can be done flexibly, taking into account the targets of both countries. The information flow works well, especially regarding generating hydro-energy: power companies exchange data across the border. The fact that the river banks are not densely populated, especially on the Russian side, helps with the implementation of the discharge rule. However, there is not a common way to evaluate damage on both the Russian and Finnish sides. It remains unclear what the damage potential on the Russian side is.

The implementation of the common discharge rule could be further improved through:

- More information on the dependence of flood damage on discharge on the Russian side of the river.
- An increase of the maximum installed discharge capacity of the Russian hydropower plants to the same level as in the Finnish plants, to improve the efficiency of flood protection.
- More statistical and real-time data on hydrology and meteorology on the northern part of the discharge area, to improve the forecasts.
- Studies on the possible need of modifications in the discharge rule, because of the anticipated effects of climate change.

The case of the Vuoksi shows that there are options for cost recovery and the redistribution of benefits and costs. Joint flood risk management can include economic interests. Interventions upstream can have (positive or negative) effects downstream and sometimes the other way around as well. Options for cost recovery of flood risk management and redistribution of benefits and costs will strengthen the integrated approach of flood risk management. The Vuoksi case is one of the few good practice examples of monetary compensation for transboundary damages due to the regulation the water levels.

3.3 Conclusions

Flood risk management planning in transboundary river basins requires a joint approach to improve the knowledge base, broaden the space for solutions, integrate strategies and find synergies between water functions. Transboundary cooperation has numerous potential benefits. A first

step in joint integrated flood risk management is the realization of a system of information exchange, joint flood forecasting and early warning systems. In many river basins, this first step has been taken. With the step to joint flood risk management planning, however, the complexity of cooperation increases. Due to the difficulties, joint flood risk management planning is not yet a frequent practice, despite the advantages, as shown in the case of the Vuoksi.

Preconditions for effective joint flood risk management include:

- **Creating the institutional and legal basis.** (See also chapter 4.) Riparian countries, or even regions and provinces within a country, often lack harmonized policies, legislation or agreements with regard to water resources and/or flood risk management. As the cases of the rivers Sava, Vuoksi and Morava show, transboundary agreements and joint commissions are crucial for joint planning.
- **Soundness of the joint institutional structure.** As the example of the Kura shows, a general precondition for integrated transboundary water resource management is that a joint body is established. Transboundary cooperation on flood risk management planning also requires a sound institutional framework for cooperation as well as clear water policies and transparent administrative structures in all the countries involved. The management of the Kura has great potential for improvement.
- **An understanding of mutual benefits and threats, common goals and shared interests.** Land use, development perspectives and other issues in a river basin vary from location to location and between riparian countries. A common understanding of each other's objectives as well as identifying each other's benefits provides a basis for joint planning. As the case of the Vuoksi illustrates, knowledge and understanding of the situation in the neighbouring country is essential for a joint flood risk management plan. Without common goals, there cannot be sustainable cooperation.
- **Options for cost recovery and redistribution of benefits and costs.** Joint flood risk management plans need to address multiple interests, on both sides of the border. Some interests can be expressed in economic terms (e.g. energy, transport), while others cannot or can only be with difficulty (e.g. nature). In addition, interventions in one location may have consequences, positive or negative, on other locations. Analysing options for cost recovery and compensation of flood risk management services or redistribution of benefits and costs will thus strengthen the integrated approach of flood risk management. This is well illustrated by the Vuoksi case.
- **A participatory approach.** Consultation with local and regional stakeholders to identify their needs, problems and priorities will contribute to effective flood risk management planning. For a transboundary approach, it is important to involve the public in the entire river basin. In the presented cases this aspect was not addressed.
- **Long-term engagement and commitment.** Building trust and confidence in a complex field such as flood management requires much time, as the work is prone to setbacks due to changes in national priorities and political change. It is essential to establish a permanent basis for cooperation at the technical level.

4. Institutional and legal arrangements for cooperation

4 Institutional and legal arrangements for cooperation

4.1 The legal and institutional settings for (transboundary) cooperation

Being an interdisciplinary challenge, flood management calls for interaction between various disciplines, government and various sectors of society. There is a need to overcome sectoral approaches so that the synergies between the actions of various stakeholders can be maximized and effectiveness can be increased. Institutional and legal arrangements are necessary elements of successful integrated flood risk management. In the case of transboundary basins, this includes the need to cooperate at the transboundary level.

In the institutional setting of a policy field, in this case integrated flood risk management, various layers can be distinguished:

- Legal setting: National laws, regulations, directives and international agreements and treaties, e.g. the UNECE Water Convention, together form the legal framework.
- Organizational setting: Institutions and organizations that are involved in integrated flood risk management (on various governmental levels), as well as their mutual relations and cooperation.
- Policy arrangements: Policies, policy intentions and plans that influence flood (and water) management on various governmental levels.

4.1.1 Legal setting

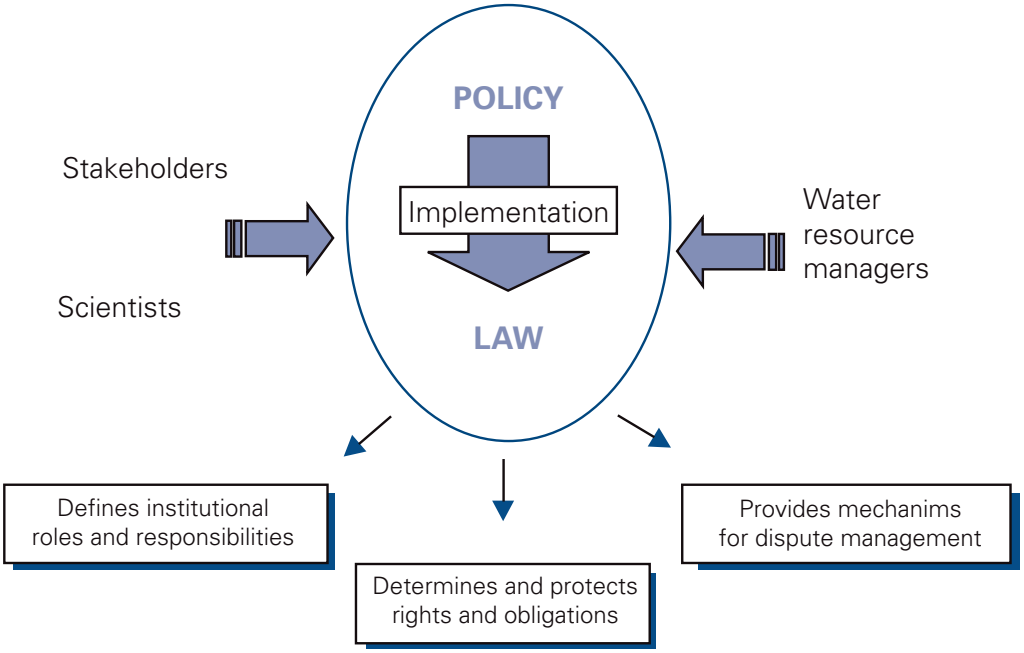
Law plays a vital role in the effective implementation of integrated flood risk management. At the transboundary and international levels, international legal frameworks such as the UNECE Water Convention and the EU Floods Directive set general obligations for countries regarding flood risk management and transboundary cooperation (see chapter 1). At the national level, standards of performance and a clear definition and distribution of duties, rights and powers of the various organizations involved should be set out in law. Similarly, procedures and requirements regarding monitoring of compliance and mechanisms for enforcements must be established. The law needs to provide appropriate mechanisms for the settlement of disputes. WMO and the Global Water Partnership (GWP) developed a Rapid Legal Assessment Tool[27] to identify legal instruments that might be needed for a consistent and effective integrated flood risk management. Figure 5 illustrates the roles that a legal framework plays in the implementation process of flood management policies.

At the international level, integrated flood risk management should be linked with wider frameworks of integrated water resources management. The no-harm rule and the rule of equitable and reasonable use should, for example, be implemented as stipulated by the Water Convention. Legally binding commitments may be of help for a transboundary approach, but are not absolutely necessary; voluntary agreements can also be effective if the Parties concerned are committed to their implementation. In the Rhine River basin, for example, the decisions of the International

[27] See APFM 2006a.

Commission for the Protection of the Rhine (ICPR) are not directly binding, but are implemented by the riparian Parties, who translate them into national laws and regulations.

Figure 5: Roles of law.



Source: APFM, 2006a. Legal and institutional aspects of integrated flood management.

4.1.2 Organizational setting

The achievement of integrated flood risk management in river basins is highly dependent on the organizational setting, both at the national and at the transboundary level. From a national perspective, integrated flood risk management requires that various roles are played by a complex set of actors and that cooperation and coordination across institutional and disciplinary boundaries is ensured. At the various governmental levels (national, regional and local), decision-making requires coordination so that decisions take account of any impacts on flood management.

Organizations that are involved in water management at the national, regional and local levels therefore need a clear allocation of responsibilities and mandates. In transboundary river basins, joint commissions play an important role in sharing knowledge and information and in coordinating flood risk management planning. To achieve transboundary coordination and cooperation, it is essential that within a river basin an unambiguous overview is created of who is involved in water management at the various levels, and how.

4.1.3 Policy arrangements

Integrated flood risk management requires both the horizontal and vertical integration of plans, programmes and policies. Horizontal integration refers to the multidisciplinarity of the approach and the involvement of various water users. Vertical integration means that transboundary, national and local plans, programmes and policies are considered and implemented at the differ-

ent levels. The starting point for all policy arrangements needs to be the setting of explicit and common goals. This will provide a basis for integration with other policy fields, for identifying incompatible interests and for exploring synergies, eventually resulting in cost recovery. For transboundary flood risk management, common goals are a precondition as well; without them, there will be no cooperation.

4.2 Case descriptions regarding institutional and legal arrangements for cooperation

Three cases were presented and discussed:

- The Dniester River, shared by Ukraine and the Republic of Moldova.
- Cooperation between Hungary and Ukraine
- The Elbe River, shared by Austria, the Czech Republic, Germany and Poland

4.2.1 Dniester River[28]

The Dniester River originates in Ukraine; it marks the boundary between Ukraine and the Republic of Moldova and thereafter flows through the Republic of Moldova for 398 km. It is the largest river in the Republic of Moldova. Further downstream, it forms an additional part of the Moldovan-Ukrainian border, before flowing back to Ukraine and emptying into the Black Sea.

In the Republic of Moldova and in the Dniester basin, land use is mostly agricultural (arable lands > 76 per cent in the Republic of Moldova). There has been dramatic deforestation in the Ukrainian Carpathians.

The influence of hydropower is large. There is a domination of hydropower interests compared to other stakeholders, which has serious impacts on downstream ecosystems, and effective stakeholder involvement in decision-making is lacking. There is no effective land-use planning and implementation of IWRM principles is weak. Construction in flood-prone zones is still ongoing. Despite the presence of structural measures such as reservoirs and information exchange with Ukraine, extreme events can cause considerable damage in the Republic of Moldova.

Institutional and legal arrangements are important for cooperation at the transboundary level. Since 1994, there is an intergovernmental agreement between the Republic of Moldova and Ukraine on border waters. In addition, in 1998, an intergovernmental agreement was concluded between the two countries on the prevention of industrial accidents, calamities and natural disasters. In 2006, a protocol on flood control was added to the 1994 agreement on border waters. It is related to the zone of joint borders only, and has a limited number of monitoring points. There is no river basin approach and stakeholder involvement in decision-making is weak. Information exchange and timely notification on floods are poor.

At the national level, the fragmentation of institutions responsible for flood management complicates the situation: emergency agencies, the State water management agencies, the State authorities for natural resources and for navigation, and local authorities are all involved in flood risk management.

[28] Based on a presentation by Mr. Trombitsky, ECO-TIRAS, Republic of Moldova, and the discussion following.

At the basin level, transboundary early warning and contingency planning could be improved, for example through the establishment of a computerized transboundary information and flood forecasting system.

In addition, improving the legal framework for transboundary cooperation regarding flood management through the establishment of an agreement and a river basin commission is needed to reduce flood risk. A new agreement for the whole Dniester was elaborated under an Environment and Security (ENVSEC) Initiative project, jointly implemented by OSCE and UNECE. The draft agreement foresees a new institutional structure; however, it has not yet been adopted by the riparian countries. In addition, it is a challenge to harmonize water uses, e.g. for hydropower, with other needs, especially with ecosystem needs.

There is willingness to cooperate and an understanding of the necessity to cooperate on the river basin at the transboundary level, but experience is lacking. Challenges to cooperation include the lack of political will, differing perceptions of problems on the part of the two countries, the difficulty of accessing existing external funds to support cooperation, and the lack of expertise in flood modelling at the river basin level.

Improved cooperation would have several potential benefits. Flood damages could be prevented, river basin management improved and the interests of water users harmonized. It is also expected that transboundary cooperation will lead to less water pollution, cleaner drinking water, and better flood forecasting and announcements. Urgent repairs and essential improvements to levees and flood control facilities should lead to increased flood protection of urban areas.

The Dniester basin is a good example of an East European transboundary river where a flood forecasting and alert system for the whole basin should be developed. But successful flood management for the Dniester requires improvement of legal and institutional cooperation, based on the principles of the UNECE Water Convention.

4.2.2 Cooperation between Hungary and Ukraine[29]

Hungary has typical downstream conditions: 96 per cent of the surface water resources as well as floods are generated outside the country. Twenty-four rivers flow into the country, and only 3 flow out. The length of the primary defences is 4,200 km. The area of protected fluvial floodplain is 21,200 km², which is 23 per cent of the territory of the country. The case is unique in Europe, even compared to the Netherlands.

This also explains Hungary's huge vulnerability to floods. Small floods occur every 2–3 years in the country, significant ones every 5–6 years, and devastating ones every 10–12 years. On the other hand, droughts occur every 3–5 years. River levels can rise quickly: up to 12 m in two days, similar to flash floods. The population affected is as large as 2.3 million; total value at risk is estimated at US$ 30 billion.

Cooperation between Hungary and Ukraine has a long history. A transboundary Water Management Committee has existed since 1947 (at the time with the Soviet Union). The Tisza Forum has been in existence since 2001; it involves Hungary, Romania, Serbia, Slovakia and Ukraine. Thanks to joint projects and the funding provided, monitoring in Ukraine has been improved and the data centres of Slovakia, Hungary and Ukraine have been connected.

There have been several joint projects between Hungary and Ukraine. These included research on the effects of deforestation, the construction of a joint Hungarian-Ukrainian remote sensing system, the maintenance of a joint monitoring system, projects concerning impact assessment of flood protection systems, harmonization of design flood levels and a training plan for the Tisza River. Flood reduction reservoirs on the Ukrainian side and more room for the river on the Hungarian side are part of the negotiations. The cooperation between Ukraine and Hungary is fruitful.

4.2.3 Elbe River[30]

The Elbe River basin is shared by four countries: Germany (65.5 per cent), Czech Republic (33.7 per cent), Austria (0.6 per cent) and Poland (0.2 per cent). The upper Elbe basin in the Czech Republic consists mostly of highlands and low mountains. The middle part is a lowland area in central and northern Germany. The lower part of the river runs through the German lowland to the North Sea and is affected by the tidal regime of the North Sea. Due to the different characteristics in the different parts of the river basin, a variety of flood types occur.

Cooperation is maintained through the International Commission for the Protection of the River Elbe, established in 1990. In 2009, Parties to this Commission are the Czech Republic and Germany; Poland, Austria, the European Union, the river basin Commissions for the Danube, Rhine and Oder as well as several Non-Governmental Organizations participate as observers.

Since the 1980s, flood frequency appears to have increased. Both the International Commission for the Elbe Protection and the Czech-German Commission for boundary waters focus on aspects of water resources management, including floods.

The main tasks of the International Commission for the Protection of the River Elbe are:

- To enable water usage, first of all from river bank infiltration for drinking water supply

[29] Based on a presentation by Mr. Bakonyi and Mr. Magyarics, Hungary, and the discussion following.

[30] Based on a presentation by Ms. Soukalová, Czech Hydrometeorological Institute, on behalf of Mr. Danhelka and Mr. Kubát, and the discussion following.

- To enable usage of water and sediments for agriculture purposes
- To achieve a natural ecosystem, with appropriate flora and fauna species
- To decrease the pollution load to the North Sea from the Elbe basin
- To improve flood protection in the basin (added in 1997)
- To coordinate implementation of the EU Water Framework Directive (added in 2000)
- To coordinate implementation of the EU Floods Directive (added in 2007)

An important step in the management of the Elbe River has been the development of a joint knowledge base in both Czech and German.

A working group on floods prepared a Flood Action Plan of the Elbe River basin, which was adopted in 2003. Its main elements are:

- Analyses of hydrological aspects of floods and their forecasting
- Principles to increase the retention capacity of catchments by measures in agriculture, forestry and infrastructure
- Study of former inundation areas and possibilities for their renewal
- Study of technical flood protection measures (e.g. polders, levees)
- Study of the influence of large reservoirs on the flood regime of the Elbe River
- Modernization of the gauging network and data transfer system
- Start of a shared international flood forecasting system in the basin, including Czech and German federal and land authorities.

The Flood Action Plan was developed by competent national authorities and is checked and updated every two years by the Elbe Commission. It has been followed and supported by other projects (e.g. for harmonization of spatial planning and land use principles).

Data and information exchange is done based on a bilateral intergovernmental agreement between the Czech Republic and Germany. The Czech Republic provides Germany with data on water levels, discharges, precipitation, hydrological forecasts and websites from about 300 water gauges, 80 reservoirs and 52 forecasting sites (measured data are updated hourly). A selection of data is sent using a ftp server (twice a day, and in the event of floods, on an hourly basis). Germany provides the Czech Republic with data on water levels and precipitation in border areas. A first step in the cooperation was the development of forecasting capabilities and the setting up of an early warning system for the whole river basin. Web-based flood warning involves four levels of alert.

The case of the Elbe river is an example of advanced cooperation in joint flood risk management planning. It shows that flood protection systems are often established in response to extreme situations, which make the need for measures clear, including problems and weak points. In addition, cooperation is aided by the existence of political will, especially on the part of decision makers, who technically and financially support the development of flood protection systems. Personal contacts facilitated cooperation of bodies involved, covering research, development, operations, meteorology, hydrology and water users.

Despite the advanced level of cooperation, further improvements have been recommended, e.g. forecasting procedures could be improved through higher reliability and longer lead times. In addition, a closer link between the forecasting agencies, including improved personal contact, would be of use. There are still language problems to overcome. English could be used as a shared means of communication. Finally, one international (transboundary) forecasting institution

responsible for the whole basin could be established. It could serve as a basis for the implementation of regional forecasting systems such as EFAS, or provide regional flash flood guidance in the Elbe River basin.

4.3 Conclusions

- **A stepwise approach.** Developing joint flood risk management on a project basis could be an effective first step to successful cooperation. Exchange of information, for example, may not require any formal treaties, although in some cases it might prove difficult without political will (e.g. a written agreement). Subsequent steps might be the development of transboundary plans and their implementation. The advantage of a stepwise approach is that the participants in the process are able to familiarize themselves with (possible) differences in procedures, structures and cultures. This can contribute to the development of mutual trust. A further benefit of a step-by-step process is that it will allow the pros and cons, success factors and obstacles to be evaluated at each step. Every step must be assessed by considering the overall policy objectives. These common objectives must be addressed at the policy level and, if needed, be fixed in legal arrangements.
- **A participatory approach.** IWRM – and thus integrated flood risk management – implies that those who are interested in or will be affected by decisions on water resources are involved in basin management and that information is exchanged freely. Free access to information is crucial to finding good solutions. Where there is no transparency or accountability and where those affected are excluded, it is difficult to put the IWRM approach into practice. Therefore, it is imperative that all stakeholders are involved from the start in the decision-making processes that affect flood management. The level of participation of the different interested groups may vary both in terms of degree and in the level at which it occurs, whether national or local. But greater participation of all stakeholders in flood policy development is vital, since it enables the inhabitants of flood-prone regions to choose the level of risk they are ready to take. Further stakeholder buy-in is required to share responsibilities that go beyond the paradigm of traditional engineering-based flood defence.

  A shared consensus has emerged in the past decade with respect to the importance of participatory planning in disaster management. Individual and community ownership, commitment and concerted actions in disaster mitigation produce a wide range of appropriate, innovative and feasible mitigation solutions that are cost-effective and sustainable. In addition, public participation adds to reducing the fears and resistance of stakeholders and increases democracy in planning processes. From a transboundary perspective, it is important to increase public awareness of the fact that people share the same water resources and depend on one another for its management.

  At the moment, the focus in integrated flood risk management lies primarily on the level of governments and experts. For successful implementation, however, a participatory approach should be established as soon as possible. Joint programmes for informing public stakeholders, involving them in decision-making processes and creating awareness can be a good starting point for transboundary cooperation.
- **Strong legal and institutional arrangements.** Emergency cases are an important driver of present flood management. Although transboundary cooperation during calamities is important, it will not be enough for a real integrated approach. Transboundary cooperation during calamities could be used as a triggering event for a long-term integrated approach in water resources management. On the national level, the necessity of robust flood management is often not understood by the population and politicians until after a significant flood event. Similarly, climate change represents a new challenge, but also an opportunity for joint research and adaptation planning in consultation.

Water resources management goes beyond flood management; it implies durable institutional arrangements. To be long-lasting, the agreements must be flexible enough to adapt to changing circumstances (e.g. climate, society), but should not be subject to (changes in) political ideology. This requires due consideration that the regulatory instruments to be put in place are flexible. Rather than relying solely on formal laws and detailed regulations, the whole range of options at the disposal of Governments to incentivize intended behaviour or land use should be considered (e.g. tax incentives for flood-proofing in existing flood hazard zones).

5. Wrap-up and recommendations

5 Wrap-up and recommendations

Floods can have beneficial effects if managed properly and at the river basin scale. The flood risk management cycle should form the basis for comprehensive cooperation: lessons from experiences should be assessed, documented and taken into account in the flood risk cycle, but also shared with other countries. Various layers and opportunities are available to establish transboundary cooperation.

Transboundary flood risk management requires international cooperation and is an imperative for the prosperity of nations, including safety, health, economic and peace aspects.

Transboundary flood risk management should be considered as a part of IWRM. In transboundary river basins, IWRM involves international cooperation among all riparian countries, in particular between neighbours. Bilateral and multilateral cooperation are both needed, and should reinforce each other.

Transboundary flood risk management has both technical and political aspects. In many situations, technical cooperation is ahead of institutional and political cooperation. At the technical and expert levels, it is often easier to start cooperation and address the problems linked to transboundary flood risk management, thereby starting to build trust. In many countries, however, political support for transboundary flood risk management is weak. It is necessary to ensure and strengthen political support to enable sustainable cooperation on transboundary water management.

The UNECE Water Convention is an important instrument for promoting the institutionalization of international cooperation. It provides a useful framework for transboundary flood risk management. However, compliance with the Convention needs to be strengthened.

A wealth of guidance and technical papers describing the options and measures for flood risk management at international level are available, e.g. from the EU, UNECE and WMO. Many examples of international cooperation on transboundary flood risk management also exist. Countries should make use of them.

Good transboundary communication is essential for cooperation. The same is true for effective transboundary flood risk management. Insufficient communication between riparian countries is not so much a technical issue as it is a political and partly a legal one. Informal meetings can help parties to make the first steps. Joint problem definition and a common understanding of interests among all riparian countries are important for stimulating and improving transboundary cooperation.

Sharing hydrometeorological data across borders is a basis for cooperation and should be endorsed by Governments. Data sharing and also the quality and reliability of information need to be improved in many cases, inter alia, to help reach a common understanding of the situation.

Although in most countries the level of expertise is sufficient to deal with flood-related issues, expertise in producing flood risk maps varies significantly. This includes know-how and availability of technical infrastructure for data exchange, modelling and mapping.

Joint bodies such as river basin commissions can help facilitate international cooperation, including the sharing of data. Where there are no transboundary river basin commissions, these should be established, preferably at a high institutional level and with political support to ensure sufficient funding for all joint activities. Institutional and political cooperation should aim to keep pace with the level of technical cooperation at the transboundary level. All riparian countries

should be involved. A joint legal framework is needed to sustain technical cooperation. Formal agreements for cooperation should be flexible and should be based on a cross-sectoral approach.

In EECCA and SEE countries, improved political stability and access to funds to support activities related to water management are needed. Funding is problematic in many cases; this is also related to political support. Transparency with respect to funding sources is needed.

Pilot projects are also needed to improve transboundary flood risk management in specific basins. Regional and subregional workshops on transboundary flood management are also a useful tool for exchanging good practices and discussing problems and experiences. Finally, capacity-building and training at both the technical and the decision-making levels can help improve both the knowledge base and international cooperation.

References

APFM, 2006. *Environmental aspects of integrated flood management*. Available online at: http://www.apfm.info/pdf/ifm_environmental_aspects.pdf.

APFM, 2006a. *Legal and institutional aspects of integrated flood management*. Available online at: http://www.apfm.info/pdf/ifm_legal_aspects.pdf.

APFM, 2006b. *Social aspects and stakeholder involvement in integrated flood management*. Available online at: http://www.apfm.info/pdf/ifm_social_aspects.pdf.

Bates, B.C. et al. (eds.), 2008. *Climate Change and Water*. Technical Paper of the Intergovernmental Panel on Climate Change, Geneva, IPCC secretariat.

EC, 2000. Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000, establishing a framework for Community action in the field of water policy.

EC, 2003. *EU Best Practices Document on Flood Prevention, Protection and Mitigation*. Available online at: http://ec.europa.eu/environment/water/flood_risk/pdf/flooding_bestpractice.pdf.

EC, 2007. *Communication from the Commission to the European Parliament and the Council addressing the challenge of water scarcity and droughts in the European Union*. COM (2007) 414 final.

EC, 2007. *Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks*. Available online at: http://ec.europa.eu/environment/water/flood_risk/index.htm.

EC, 2009. *White Paper Adapting to climate change: Towards a European framework for action*. COM(2009) 147 final. Available Online at:http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52009DC0147:EN:NOT

EXCIFF, 2005. *Flood forecasting in Europe: Current practices, needs and proposed actions to go forward*. Available online at: http://exciff.jrc.ec.europa.eu/downloads/exciff-related-documents/EXCIFF_Current_practices_Doc1_2005.doc/view.

EXCIFF, 2006. *Final report of the workshop "Exchange of experiences with flood modelling of different types of floods and river basins in Europe"*. Available online at: http://exciff.jrc.ec.europa.eu/downloads/exciff-related-documents/EXCIFF_2nd_workshop_report.zip/view.

EXCIFF, 2007. *Good practice for delivering flood-related information to the general public.* Available online at: http://exciff.jrc.ec.europa.eu/downloads/exciff-related-documents/EXCIFF_guide.pdf.

EXCIMAP, 2007. *Handbook on good practices for flood mapping in Europe*. Available online at: http://ec.europa.eu/environment/water/flood_risk/flood_atlas/index.htm.

FLAPP, 2006. *Flood awareness & prevention policy in border areas*. FLAPP Network (Swanenvleugel, B., and A. Laninga-Busch). Available online at: http://www.flapp.org.

INBO/GWP, 2009. *A Handbook for Integrated Water Resources Management in Basins*. Available online at: http://www.inbo-news.org/gwp/handbook/GWP-INBOHandbookForIWRMinBasins.pdf.

NeWater, 2005. *Transboundary river basin management – state-of-the-art review on transboundary regimes and information management in the context of adaptive management*. Available online at: http://www.usf.uni-osnabrueck.de/projects/newater/downloads/newater_rs10.pdf.

NeWater, 2005/2. *Transboundary river basin management regimes: the Tisza basin case study*. Available online at: http://www.semide.net/topics/swrm/transboundary-river-basin-management-regimes.

Swanenvleugel, B., 2007. *Quick scan of the institutional setting in four European river basins.* Report in the framework of the proposed project 'Water Implementation Strategy for EU Flood Directive' for Euregion Meuse-Rhine; Play-Time, Meerssen.

Swanenvleugel, B., 2008. *Freude am Fluss – an innovative approach to river management*. Radboud University, Nijmegen. Available online at: http://www.freudeamfluss.eu.

UNDP, 2006. *Transboundary River Basin Management in Europe*. Available online at: http://hdr.undp.org/en/reports/global/hdr2006/papers/Barraque_Bernard%20et%20al.pdf.

UNECE, 1992. *Convention on the Protection and Use of Transboundary Watercourses and International Lakes*. Available online at: http://www.unece.org/env/water/.

UNECE, 2000. Guidelines on Sustainable Flood Prevention. http://www.unece.org/env/water.

UNECE, 2003. *Transboundary water cooperation in the newly independent States*. Available online at: http://www.unece.org/env/water/documents/transbwatcoopnis_fin_e.pdf.

UNECE, 2006. *Model Provisions on Transboundary Flood Management*. Available in annex I to this document or online at: http://www.unece.org/env/documents/2006/wat/ece.mp.wat.19_ADD_1_E.pdf.

UNECE, 2006a. *Strategies for monitoring and assessment of transboundary rivers, lakes and groundwaters*. Available online at: http://www.unece.org/env/water/publications/documents/StrategiesM&A.pdf.

UNECE, 2007. *Recommendations on payments for ecosystem services in integrated water resources management*. Available online at: http://www.unece.org/env/water/publications/documents/PES_Recommendations_web.pdf

UNECE, 2007a. Our *Waters: Joining Hands across Borders – First Assessment of Transboundary Rivers, Lakes and Groundwaters*. Geneva, UNECE.

UNECE, 2009. *Guidance on Water and Adaptation to Climate Change*. Geneva, UNECE.

WMO/GWP, 2004. *Integrated Flood Management Concept Paper*, APFM Technical Document No. 1, Second Edition. Available online at: http://www.apfm.info/pdf/concept_paper_e.pdf.

WMO/GWP, 2006. *Managing Transboundary Floods* (leaflet). Available online at: http://www.apfm.info/pdf/APFM_TFM_flyer_lowres.pdf.

WMO/GWP, 2008. *Making integrated flood management part of the development agenda*. (brochure). Available online at: http://www.apfm.info.

Annexes

Annex I – Model Provisions on Transboundary Flood Management[31]

Introduction

1. The following Model Provisions on Transboundary Flood Management adopted by the Parties to the Convention at their fourth meeting are meant to help States in developing either a general bilateral or multilateral normative instrument on transboundary water issues or a flood-specific one among Riparian States, in order to address transboundary flood prevention, protection and mitigation and enhance preparedness thereto. The Model Provisions may need to be adapted by the Riparian States according to their specific needs. On the other hand, States may adopt further provisions dealing with these matters in more detail, or opt for more stringent measures such as those contained in Part III of the United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (hereinafter the United Nations 1997 Watercourses Convention) and in the UNECE 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes (hereinafter the UNECE 1992 Water Convention).
2. It is understood that general principles of international law related to matters covered by these model provisions are fully applicable, as appropriate.
3. For the purposes of these provisions:

   (a) "Parties" means parties to any instrument in which these provisions may be incorporated;

   (b) "Riparian Parties" means Parties bordering the same transboundary watercourse.
4. Throughout the provisions, wording suitable to legally binding instruments has been used (e.g. "shall do"). If States choose a soft law type of instrument, then different wording (e.g. "should do") should be used.

Provision 1

1. **The Riparian Parties shall take all appropriate measures to prevent, mitigate and protect against flood risks in transboundary river basins. Flood risks are the probability of flood occurrence combined with its possible adverse impact.**
2. **Each Party shall refrain from taking action or adopting measures which may, directly or indirectly, result in a transfer of flood risks to other Riparian States or generate flood risks in such other Riparian States.**

[31] As adopted at the fourth session of the Meeting of the Parties to the UNECE Water Convention in 2006, available online at: http://www.unece.org/env/documents/2006/wat/ece.mp.wat.19_ADD_1_E.pdf

Commentary to provision 1

1. Paragraph 1 of provision 1 is an enunciatory statement covering the whole Model Provisions, reflecting the most fundamental principle thereof and also defining the term "flood risks". As to the definition of "impact", reference can be made to article 1, paragraph 2 of the UNECE 1992 Water Convention.
2. As far as paragraph 2 is concerned, national flood protection measures should always take into account their possible impact on other Riparian States. Paragraph 3.2 (bullet 4) of the 2004 Action Programme for Sustainable Flood Protection in the Danube River Basin states that "Rivers do not recognize national borders. Experience has shown that local flood protection measures can have negative effects both downstream and directly upstream. Therefore these effects need to be assessed..." The term "generate flood risks" is intended to include man-made floods.

Provision 2

The Parties shall jointly develop a long-term flood management strategy and measures covering the transboundary river basin. Their cooperation shall include:

(a) Monitoring/data collection, exchange of hydrological and meteorological data, and development of a forecasting model covering the whole river basin or of a linkage between the Parties' respective forecasting models;

(b) Preparation of surveys, studies (including cost-benefit or cost-effectiveness analysis), flood plain maps, flood risk assessments and flood risk maps, taking due account of local knowledge, and exchange of relevant national data and documentation;

(c) Development of a comprehensive flood action plan or a set of co-ordinated flood action plans addressing prevention, protection, preparedness and response and providing for common objectives, joint action, contingency plans, information policy, flood plain management and, where appropriate, flood control works and financing mechanisms;

(d) Raising awareness and providing access to information, public participation and access to justice.

Commentary to provision 2

1. This provision establishes the principle of long-term cooperation between Riparian Parties on flood issues for the whole river basin as part of an integrated river basin management. Paragraph 2.1 of the communication of the European Commission on flood risk management (document COM (2004) 472) rightly states that "If one area implements engineering solutions to evacuate the water from its stretch of the river as quickly as possible, this simply means that the water arrives faster to their downstream neighbours. Therefore, it is imperative that flood protection is dealt with in a concerted and coordinated manner along the whole length of the

river".[32] In this context, flood risk management should be coordinated with and, where appropriate, integrated into river basin management planning and be linked with other policy fields, such as urban planning, rural and industrial development, agriculture, transport and recreation. Established joint bodies between the Riparian Parties constitute the appropriate framework for such cooperation.

2. The fields of cooperation mentioned in subparagraphs (a)–(d) are of an illustrative character, and no hierarchy is established among them, as it is for the Parties to fix the priorities of their common action in accordance with the specific needs of each river basin. The matters suggested in subparagraphs (a)–(d) are often mentioned in bilateral conventions, the Guidelines on Sustainable Flood Prevention (UNECE Guidelines) and also the New York Flood Control Rules (1972) of the International Law Association (ILA), as updated and incorporated in article 34, paragraph 4, of the 2004 Berlin Rules on Water Resources of the ILA.

3. As far as exchange of data and joint development of a forecasting model are concerned, similar provisions are contained in article 9 of the United Nations 1997 Watercourses Convention; in articles 3 and 6 of the 1999 Agreement between the Government of the Republic of Kazakhstan, the Government of the Kyrgyz Republic, the Government of the Republic of Tajikistan and the Government of the Republic of Uzbekistan on cooperation on hydrometeorology; and in paragraphs 24 and 28 of appendix I to the UNECE Guidelines. Note should also be taken of paragraph 1 of Resolution 25 (Cg-XII) of the World Meteorological Organization (1999) on the exchange of hydrological data, according to which Members should provide on a free and unrestricted basis those hydrological data and products which are necessary for the provision of services in support of the protection of life and property and for the well-being of peoples.

4. The wording of subparagraph (b) is modelled on that of subparagraph (b), paragraph 4, of article 34 of the Berlin Rules on Water Resources of ILA (see also para. 23 of the UNECE Guidelines).

5. Concerning subparagraph (c), mention should be made of article 13, paragraph 1, of the 2002 Framework Agreement on the Sava River Basin and of articles 7 and 8 of the 2000 Agreement between the Government of the Republic of Kazakhstan and the Government of the Kyrgyz Republic on the Use of Interstate Water Management Installations on the Rivers Chu and Talas.

6. The use of cost-benefit and/or cost-effectiveness analysis allows for finding the most appropriate measures, with a fair sharing of costs and responsibilities, in the framework of solidarity among Riparian Parties. The establishment of suitable financial mechanisms can support the implementation of joint action.

7. This provision provides for joint action and measures by the Parties in the field of flood protection. The adoption of joint action plans by the Riparian Parties is also suggested in paragraph 22 (d) of the UNECE Guidelines and in annex A, paragraph 1 (a), of the communication of the European Commission on flood risk management (document COM (2004) 472).

8. Subparagraph (d) draws inspiration from section V of the UNECE Guidelines and from the Action Programme for Sustainable Flood Protection in the Danube River Basin (of the International Commission for the Protection of the Danube River).

[32] See also paragraph 3.2 of the 2004 Action Programme for Sustainable Flood Protection in the Danube River Basin and paragraphs 13 (c) and 22 (a) of the UNECE Guidelines on Sustainable Flood Prevention.

Provision 3

1. The Parties shall without delay inform each other about any critical situation likely to cause flooding in the other Parties' territory. The Riparian Parties shall set up and operate coordinated or joint communication, warning and alarm systems with the aim of obtaining and transmitting information, or adjust existing systems. These systems shall operate on the basis of compatible data transmission and processing procedures and facilities to be agreed upon by the Riparian Parties. The Riparian Parties shall designate competent authorities and points of contact at all appropriate levels and inform each other thereof.

2. Whenever one Party ascertains the existence of a situation causing or likely to cause flooding in the other Parties' territory or in the process of flooding the other Parties' territory, it shall:

(a) Immediately convey this information to the competent authorities and points of contact of the other Parties following the agreed-on procedure. Such information shall contain, inter alia, the available data on precipitation, run-off and water level;

(b) Adopt, to the extent possible, all appropriate emergency measures to prevent or mitigate the adverse impact of the flood in the other Parties' territory;

(c) Consult the other Parties without delay in order to arrive at common remedial action.

Commentary to provision 3

1. The first paragraph of this provision draws from article 14 of the UNECE 1992 Water Convention. This article puts upon the Riparian States the obligation to inform each other about any critical situation that may have transboundary impact and also to set up, where appropriate, coordinated or joint communication, warning and alarm systems. Some bilateral agreements also provide for such a communication procedure or for a common warning model.[33]

2. The second paragraph draws inspiration from article 28 of the United Nations 1997 Watercourses Convention. The first such obligation (i.e. the obligation to inform) is contained in paragraph 2 of article 28 as well as in many bilateral agreements dealing with floods.[34] The usefulness of the information provided is contingent upon the prior establishment of a bilateral warning arrangement ensuring that the information gets as early as possible to the right people.

[33] Article 16, paragraph 1, of the 1994 Convention on Cooperation for the Protection and Sustainable Use of the Danube River (Danube River Protection Convention); article 8, paragraph 1 (c), of the 1999 Convention for the Protection of the Rhine; article 11, paragraph 1, of the 1998 Convention on Cooperation for the Protection and Sustainable Use of the Waters of the Hispano-Portuguese Catchment Areas. See also paragraph 25 of the UNECE Guidelines.

[34] See article 3, paragraph 6, of the 1999 Convention for the Protection of the Rhine; article 18, paragraph 3, of the 1998 Convention on Cooperation for the Protection and Sustainable Use of the Waters of the Hispano-Portuguese Catchment Areas (1998 Convention between Portugal and Spain); article 16, paragraph 2, of the Danube River Protection Convention; article 8 of the 2000 Agreement between the Government of the Republic of Kazakhstan and the Government of the Kyrgyz Republic on the Use of Interstate Water Management Installations on the Rivers Chu and Talas; article 3 of the 1999 Agreement between the Government of the Republic of Kazakhstan, the Government of the Kyrgyz Republic, the Government of the Republic of Tajikistan and the Government of the Republic of Uzbekistan on Cooperation on Hydrometeorology. See also paragraph 24 (a) of the UNECE Guidelines.

Therefore, subparagraph (a) mentions the need for an agreed procedure for communicating the relevant data.

3. The obligation to prevent or mitigate, to the extent possible, the adverse impact of a flood in the other Parties' territory can be considered as an expression of solidarity among States and peoples in cases of national disasters. Article 28, paragraph 3, of the United Nations 1997 Watercourses Convention provides that "A watercourse State within whose territory an emergency originates shall, in cooperation with potentially affected States and, where appropriate, competent international organizations, immediately take all practicable measures necessitated by the circumstances to prevent, mitigate and eliminate harmful effects of the emergency".[35] Provisions similar to the rule in subparagraph (b) are contained in article 18, paragraph 5, of the 1998 Convention between Portugal and Spain and in article 3 of the 2001 Agreement between the Government of the Republic of Kazakhstan and the Government of the People's Republic of China on cooperation regarding the protection and use of transboundary rivers.

4. Situations likely to cause flooding include those generated by excess water of meteorological origin as well as man-made floods, including those from failure of hydraulic infrastructures, such as dams and levees, and from reservoir operation. Making information available to Riparian States on reservoir management, with special regard to discharge rate, timing of discharge and its duration, has proven to be essential in such situations.

5. In order to identify the measures to be taken in accordance with paragraph 2, subparagraph (b) of this provision, the UNECE Guidelines, the conclusions and recommendations of the UNECE Seminar on the Prevention of Chemical Accidents and Limitation of Their Impact on Transboundary Waters (Hamburg, Germany, 4–6 October 1999) and the European Union Best Practices on Flood Prevention, Protection and Mitigation can be consulted for guidance.

6. The duty to consult the other Riparian Parties is provided for in express terms only in article 10 of the 1995 Agreement on the Mekong River. However, it can be argued that the silence of the other bilateral agreements is due to the fact that such an obligation in case of emergency is inherent to the rules of bona fides between Riparian States which, moreover, have concluded a bilateral agreement regarding their transboundary waters.

Provision 4

1. The Parties shall strive to incorporate environmental requirements into their flood management strategy. In particular, they shall take, to the extent possible, all appropriate measures to maintain, improve and/or restore the natural function of the watercourse and the natural potential of the water resources; protect and restore water-related ecosystems; ensure that flow management takes into account the natural flow of solid matter; enhance interactions between river, groundwater and alluvial areas; and conserve, protect and reactivate alluvial areas as natural floodplains.

2. The Parties shall also promote, to the extent possible, measures to maintain, improve and restore the retention capacity of small watercourses, wetlands, forests, soils and grasslands throughout the river basin. To this end, they shall pursue an active policy against

[35] See also article 27 of the same Convention.

deforestation; support good agricultural practice; and promote schemes for payment for ecosystem services, where appropriate.

Commentary to provision 4

1. When formulating their flood management strategy, States should not underestimate the storage effect of soil or the importance of vegetation for regulating erosion. The water retention capacity of nature should not be set aside in favour of purely technical works. In addition to flood mitigation, the preservation and restoration, to the extent possible, of the river's flood zones also has ecological benefits in the form of preserving landscape and biodiversity, thus contributing to the fulfilment by the Riparian States of their obligation to protect and preserve the ecosystems of international watercourses, proclaimed in article 20 of the United Nations 1997 Watercourses Convention and also in article 2, paragraph 2 (d), of the UNECE 1992 Water Convention.
2. The environmental dimension of flood protection strategies has not been taken into account in the older bilateral treaties reported in the commentary to the New York Flood Control Rules (1972) of the International Law Association[36]. Nowadays there is a widespread feeling that a purely technical consideration of flood protection is outdated. The environmental dimension of flood strategy has already been taken into account in article 3, paragraphs 1 (c) and 1 (f), of the 1999 Convention on the Protection of the Rhine and in paragraphs 3.2 and 3.4.1 of the 2004 Action Programme for Sustainable Flood Protection in the Danube River Basin, where clear emphasis is placed upon the flood mitigation impact that elements of nature have. The wording of the first paragraph of this article draws inspiration from the above-mentioned paragraphs 1(c) and 1(f) of article 3 of the Convention on the Protection of the Rhine.
3. To this end, flood action plans should, where feasible, be linked with general river basin management plans, as flood strategy should "promote the coordinated development, management and conservation of water, land and related resources. Such a holistic approach is based on multilateral and even multinational cooperation, including interdisciplinary planning for the entire catchment areas" (see the 2004 Action Programme for Sustainable Flood Protection in the Danube River Basin, para. 3.2).
4. "Payments for ecosystem services" (or PES) means a contractual transaction between a buyer and a seller for an ecosystem service or a land use/management practice likely to secure that service (see the Convention's Recommendations on Payments for Ecosystem Services in Integrated Water Resources Management – ECE/MP.WAT/22). Water-related ecosystem services include flood prevention, protection and mitigation; regulating runoff and water supply; improving the quality of surface waters and groundwaters; withholding sediments, reducing erosion, stabilizing river banks and shorelines and lowering the potential of landslides; improving water infiltration and supporting water storage in the soil; and facilitating groundwater recharge. It follows from the above that flood protection is an important service that different ecosystems –

[36] However, see article 16, paragraph 2, of the 1963 Treaty Concerning the Regime of the Hungarian-Romanian State Frontier and Cooperation in Frontier Matters: "The position and direction of frontier watercourses must, in so far as possible, be preserved unchanged. To this end the two Parties shall, by agreement, take the necessary steps to remove any obstacles which may cause displacement of the beds of frontier rivers or streams or a change in the position of canals or which obstruct the natural flow of water".

forests and wetlands in particular – do provide within a given basin. PES can be an environmentally effective, economically efficient and socially equitable tool for implementing integrated water resources management, including flood management.

Provision 5

Each Party shall consult the other Party/Parties for every project which might cause, directly or due to accumulation with existing projects and activities, a significant change in the flow regime or the hydromorphological characteristics of the watercourse or of the alluvial areas which is likely to increase flood risk.

Commentary to provision 5

1 Paragraph 10 (c) of the annex to the report of the Berlin Seminar on Flood Prevention, Protection and Mitigation (MP.WAT/SEM.3/2004/3) refers to the need to take into account the principles of the UNECE Convention on Environmental Impact Assessment in a Transboundary Context and its Protocol on Strategic Environmental Assessment in order to better integrate environmental and health considerations into the preparation of flood action plans and programmes. The Espoo Convention provides, in its appendix I in conjunction with article 3, for an obligation to notify and involve in an environmental impact assessment procedure any Party that might be affected by the transboundary impact of large dams and reservoirs. The proposed provision goes further and, in accordance with the spirit of Part III of the United Nations 1997 Watercourses Convention, sets the obligation to consult the other Party for any project that might endanger the ecosystem and hydromorphological conditions of the basin in a manner likely to increase the risk of floods for it. An obligation to consult the other Party is included in paragraph 3 (b) of annex II of the 1998 Agreement between Spain and Portugal, which covers cases of significant change in the flow regime and the canalization and regularization of the riverbeds within 10 kilometres of the border. As far as the flow regime is concerned, article 25, paragraph 1, of the United Nations 1997 Watercourses Convention puts upon States a general obligation of cooperation for the regulation of the flow of transboundary waters.

Annex II – Summary of Integrated Flood Management: Concept Paper[37]

Settling on flood plains has enormous advantages, as is evident from the very high densities of human settlement in, for example, the Netherlands and Bangladesh. Disaster mitigation by restricting the occupation of flood plains and wetlands limits the potential of these lands for socio-economic development.

Integrated Flood Management (IFM) integrates land and water resources development in a river basin, within the context of Integrated Water Resources Management (IWRM), with a view to maximizing the efficient use of floodplains and minimizing loss to life. Thus, occasional flood losses can be accepted in favour of a long-term increase in the efficient use of flood plains.

Integrated Water Resources Management, which, as defined by the Global Water Partnership (GWP), is "a process which promotes the co-ordinated management and development of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems", is based on the recognition that a single intervention has implications for the system as a whole. More positively, integrating management means multiple benefits may be achieved from a single intervention.

For flood management to be carried out within the context of IWRM, river basins should be considered as integrated systems. Socio-economic activities, land-use patterns, hydro-morphological processes, etc., need to be recognized as constituent parts of these systems. A consistent approach needs to be applied to all forms of possible intervention. The entire hydrological cycle is considered rather than differentiating between floods and droughts when planning water resources development.

The aim of IFM is to put in place well-functioning integrated measures for flood management. For this, the linkages between various relevant sectors become very important. Thus, the most important key will be co-operation and coordinations across institutional boundaries, noting that the mandates of many institutions will either cover only part of the river basin or extend well beyond the basin boundary. At the core of integration is effective communication across institutional and disciplinary boundaries, which can take place only if there is a perception of common interest. Emphasis should be on the adoption of flexible strategies tailored to each flood-prone region (characterized by their various physical, social, cultural and economic aspects) – recognizing the importance of evaluating differing options and their relative advantages and disadvantages.

A participatory and transparent approach which includes a representative range of stakeholders in the decision making process is another key component of IFM. The degree of public participation can differ from region to region. However, it should not be assumed that such stakeholder involvement will necessarily result in a consensus. Therefore, a methodology for managing conflicts, possibly a formal system of conflict resolution, needs to be developed. In this context, a major challenge will be how to develop a consensus on the question of funding of overall activities when flood management is one of the main objectives, and to do this through dialogue among stakeholders – particularly in places where such practices are not commonplace.

[37] APFM Technical Document No.1, second edition, WMO, 2004. The full version is available online at: http://www.apfm.info/pdf/concept_paper_e.pdf.

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Convention on the Protection and Use of Transboundary Watercourses and International Lakes

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Since the beginning of the century, more than 3 million people were affected by floods in the region of the United Nations Economic Commission for Europe (UNECE), 1.9 million in Eastern Europe alone. On the other hand, floods are natural phenomena that can also bring benefits: seasonal floodplain inundation is essential to maintaining healthy rivers, creating new habitats, depositing silts and fertile organic material, and sustaining wetlands. The vulnerability to floods mainly depends on human activities – on location of buildings and infrastructures, the existence of early warning systems and emergency planning, appropriate legal and institutional frameworks, etc. An integrated approach to flood management, recognizing on the one hand the opportunities provided by floodplains for socio-economic activities, and on the other hand managing the associated risks, is essential for sustainable development of river basins.

Floods do not respect borders, neither national nor regional or institutional. Therefore, transboundary cooperation on flood risk management is not only necessary, but also beneficial. Early warning by upstream countries can save lives and reduce economic losses. Moreover cooperation helps to strengthen the knowledge and information base and enlarge the set of available strategies. Widening the geographical area considered in basin planning enables to find better and more cost-effective solutions and to locate measures where they create the optimum effect. Finally, disaster management is highly dependent on early information and requires data and forecasts from the whole river basin.

Numerous challenges hamper effective transboundary cooperation, in general, and cooperation on transboundary flood management, in particular. Lack of capacity and resources, insufficient data, differing institutional structures, lack of political will, and even mistrust in some cases, are serious obstacles. The UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) aims to support the creation of frameworks fostering transboundary cooperation, including on transboundary flood risk management.

This publication is based on the discussion and findings of the Workshop on Transboundary Flood Risk Management organized under the Water Convention in April 2009, in cooperation with the Government of Germany, the Government of the Netherlands and the World Meteorological Organization (WMO). It builds on the practical experience in ten river basins in the UNECE region.

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