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Conference Report

Second Workshop on Transboundary Flood Risk Management

Geneva, 19 – 20 March 2015

Note and Acknowledgment

This publication is based on presentations, discussions and findings of the Workshop on Transboundary Flood Risk Management (Geneva, 19–20 March 2015) 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.

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This publication was prepared by Maria Berglund and Thomas Dworak (Fresh Thoughts) plus Stefan Görlitz and Eduard Interwies (InterSus). The picture on the front page is provided by plus Stefan Görlitz.

Further information about the workshop, including presentations and the discussion paper, is available at: http://www.unece.org/env/water/workshop_flood_risk_management_2015.html#/.

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1. Setting the Scene

Floods and their related flood regime are essential events that determine the natural characteristics of an aquatic environment and its connected wetlands and floodplains, as well as ensure a functioning ecology.

During the last years, an increasing trend in extreme flood events has been registered in the UNECE region. This has been reflected especially in an increase in economic, social and environmental losses caused by flood events. Major flooding occurred across Europe during the summer of 2013, recalling the significant floods in 2002, with further major events throughout 2014. After the storm surge in northern Europe in October 2014, then flooding and storms in Slovenia, Czech Republic and parts of the Balkans, the severe weather moved to parts of southern Europe, hitting Greece and Turkey significantly. In 2014, heavy rains during the summer caused significant damage in southern Siberia, affecting an area covering 400.000 km^2, the worst floods since record-keeping began. Southeast Asia also saw large-scale flooding return in 2013, with Cambodia being hit the hardest. At the same time, flood prone areas represent vital assets to the economy of many members of the region, and an eventual relocation of activities out of the floodplains is not an option.

Due to the transboundary nature of many rivers, flooding often has transboundary consequences. Not only do flood events have to be analysed in a transboundary context, but the effectiveness of measures also needs to be assessed as they may have cross-border relevance and thus cooperation is required. Measures to reduce the impact of flood events, like dike building or floodplain restoration, need to be coordinated to ensure their best placement within a river catchment to maximize their preventative impacts. Construction activities like damming or other economic activities that could affect a river's ability to store water during flooding also need to be coordinated between neighbours to make sure that such activities don't exacerbate flood problems in neighbouring countries. A study on floods in a transboundary context concluded that although only 10 percent of all river floods are transboundary, these floods represent a considerable amount of the total number of casualties, displaced/affected individuals and financial damages worldwide[1], suggesting that improved transboundary cooperation can significantly reduce the impacts of floods.

The main 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. Moreover, flood forecasting and disaster management are highly dependent on early information sharing and requires forecasting data from the river basin as a whole.

To this end, a workshop on transboundary flood risk management was held from 19-20 March 2015 in Geneva with the aim to bring together professionals from all over the world working on transboundary flood risk management and to provide a platform to:

- Exchange experiences concerning the latest developments and the progress made in the transboundary case studies since the 2009 Workshop;

[1] Bakker, M. H. N. (2009): Transboundary river floods: examining countries, international river basins and continents. Water Policy 11 (2009) 269–288.
http://www.transboundarywaters.orst.edu/publications/abst_docs/Bakker%20Transboundary%20Floods%2009.pdf

- Identify relevant problems, successful strategies for transboundary flood risk management and new cooperation models and develop new ideas and approaches;
- Present best practice examples of successful transboundary cooperation on flood risk reduction and management;
- Analyse lessons learned from the latest flooding events in 2013 and 2014;
- Consider the experiences made in the European Union during the implementation of the EU Floods Directive and the current work on flood risk management plans; and
- Review and update the recommendations of the 2009-workshop[2].

The basis for the report on transboundary flood risk management are the different contributions received, illustrating the theory.

Table 1 List of Case Studies received

River Basin	Countries covered by the submitted case study	Contact*
Amur Basin	China, Russia	Eugene Simonov
Bug Basin	Belarus, Poland	Vladimir Korneev
Chindwin Basin	Myanmar	Htay Htay Than
Danube Basin	Austria, Bulgaria, Bosnia and Herzegovina, Croatia, Czech Republic, Germany, Hungary, Moldova, Montenegro, Romania, Slovakia, Slovenia, Serbia, Ukraine	Mary-Jean Adler
Dniester Basin	Moldova, Ukraine	Olexandr Bon, Gherman Bejenaru
Drin Basin	Albania, Former Yugoslavian Republic of Macedonia, Montenegro	Irfan Tarelli
Foron Heramce and Marquet-Swallowed-Vengeron Basins	France, Switzerland	Marianne Gfeller Quitian
Ganges Brahmaputra Meghna Basin	Bangladesh, Bhutan, China, India, Nepal	Modammad Monowar Hossain
Logone River, Lake Chad Basin	Cameroon, Chad	Younane Nelngar
Nile River Basin	Egypt, Sudan	Tahani Moustafa Sileet
Panj River Basin	Afghanistan, Tajikistan	Karimjon Abdualimov
Prut River Basin	Moldova, Romania, Ukraine	Mikhail Penkov
Rhine Basin	Austria, The Belgian Region of Wallonia, France, Germany, Italy, Liechtenstein, Luxemburg, Netherlands, Switzerland	Adrian Schmid-Breton
Tisza Basin	Hungary, Slovakia, Romania, Ukraine	Viktor Durkot

* For full contact information, please refer to the individual case studies in Annex 3

[2] Final Report of the 2009 transboundary flood management workshop is available at: http://www.unece.org/fileadmin/DAM/publications/oes/Transboundary_Flood_Risk_Management_Final.pdf

The workshop discussions produced fruitful conclusions, which are summarized at the end of each chapter. In the annexes, the individual case study submissions can be found as a source of inspiration and to show the progress made since 2009. The individual presentations from the workshop are available online at:

http://www.unece.org/env/water/workshop_flood_risk_management_2015.html#/

2. The UN flooding policy framework

The United Nations Economic Commission for Europe (UNECE) Convention on the Protection and Use of Transboundary Watercourses and International Lakes (also known as the Water Convention) is a unique legal and intergovernmental framework for supporting transboundary cooperation in disaster risk reduction. Transboundary flood risk 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 cover in detail flood management, the Convention contains many provisions relevant for the management of transboundary floods. The Convention obliges Parties to prevent, control and reduce transboundary impacts, also those resulting from floods or from unilaterally decided flood protection measures such as dams.

The Convention explicitly requires Parties to establish joint monitoring programmes for monitoring the condition of transboundary waters, including floods, as well as to establish warning and alarm procedures. Parties shall also cooperate on the basis of equality and reciprocity by concluding bilateral and multilateral agreements. They shall establish joint bodies which should provide the forum for discussing planned flood prevention measures and for agreeing on possible joint measures. Finally, Parties should assist each other in responding to and recovering from floods.

In order to support implementation of the Convention, the UNECE has also put in place several capacity-building activities, for example, the Seminar on flood prevention, protection and mitigation (Berlin, Germany, 21 -22 June 2004). In 2006 the UNECE created a new Water and Climate Task Force which was entrusted with activities in two main areas of work: transboundary flood risk management and water and climate change adaptation. In the area of transboundary flood risk management, the work programme for 2007-2009 focused on the transfer of the experience and results of the European Network of Expertise on Flood Risk Management to non-European Union countries. To this end, a Workshop on Transboundary Flood Risk Management was organized by the United Nations Economic Commission for Europe, the Government of Germany, the Government of the Netherlands and the World Meteorological Organization (WMO) on 22-23 April 2009. Based on the workshop materials, the publication “Transboundary Flood Risk Management: Experiences from the UNECE region” was developed. The publication builds on the practical experience from 10 river basins in the UNECE region and aims to document practical experience, together with general conclusions, which can be applied throughout the region.

In order to provide more detailed guidance, model provisions on transboundary flood risk management as well as “Guidance on Water and Adaptation to Climate Change” has been developed and adopted by the Meeting of the Parties in 2006 and 2009. The Guidance outlines a step-wise approach to assessing the impacts of climate change and developing appropriate policy, strategic and

operational responses on adaptation. It covers, among other issues, vulnerability assessment, prevention, improving resilience, preparation for and response to extreme events, and preparedness for recovery or aftercare.

Also, the "Guidance on Water Supply and Sanitation in Extreme Weather Events" has been prepared under the framework of the Protocol on Water and Health of the UNECE Water Convention. The Guidance is intended to provide an overview on why and how adaptation policies should consider the vulnerability of and new risk elements for health and environment arising from water services management during adverse weather episodes.

The WMO promotes the concept of Integrated Flood Management through a joint initiative with Global Water Partnership and the Associated Programme on Flood Management. Integrated flood management promotes the river basin as the basic unit for flood management, independently from any political boundaries. Moreover, the WMO is actively involved in other transboundary flood management initiatives, such as the Flash Flood Guidance System or the Flood Forecasting Initiative and promotes hydrological data sharing among riparian countries through Resolution 25.

Finally governments around the world have committed to take action to reduce disaster risk and in 2005 adopted a guideline to reduce vulnerabilities to natural hazards, called the Hyogo Framework for Action (Hyogo Framework). From 2005-2015, the Hyogo Framework for Action (HFA) is the key instrument for implementing disaster risk reduction, adopted by the Member States of the United Nations. With the 3rd UN World Conference on Disaster Risk Reduction in March 2015, the HFA has been replaced by the Sendai Framework for Disaster Risk Reduction for the period 2015-2030. While some progress was achieved in reducing losses and damages in the HFA entered into force in 2005, considerable work is still needed. The Sendai Framework has set the goal to achieve by 2030 a *substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.* Seven global targets have been address to support the achievements of the Framework's goals, elaborating quantitative targets on impacts like mortality, number of affected people, impacts to global gross domestic product and infrastructure and calling for strategies, enhancing international cooperation and an increasing in early warning systems.

3. Flood Forecasting in transboundary basins

Many measures have been devised to help communities adjust to flood hazards and reduce the negative impacts of flooding, i.e. to reduce exposure and vulnerability. These include structural (e.g. technical) and non-structural (e.g. education, warning, awareness), medium- and long-term measures. Of the non-structural measures, complementary to all other forms of intervention, flood forecasting and early warning systems have proved again and again to be an effective and efficient tool for minimizing the negative impacts of floods, and especially saving lives. While in such ways, flood risks can be managed and reduced, it has to be clear that residual risks will always remain.

3.1 Introduction to Flood Forecasting in transboundary basins

Flood forecasting and early warning systems can be described as the process of predicting the chances of and giving advice about impending floods, so that people and organizations can act to minimize a flood's negative impacts. Flood forecasting plus timely and reliable flood warning are regarded as prerequisites for the successful mitigation of or adaptation to flood damage. A combination of clear and accurate warning messages with a high level of community awareness gives the best level of preparedness for self-reliant action during floods. The position of flood forecasting and warning systems in flood risk management is depicted in Figure 1 below (note: NHMS stands for National Meteorological and Hydrological Service).

Figure 1 Framework for warning systems[3]

Different types of the forecasting steps of this process can be distinguished, depending on the staff, technologies and general resources provided for this service:

- Threshold-based flood alert: Not a quantitative forecasting, but rather a qualitative estimation of the increase in river flows/water levels, including extrapolations to revise the projection of potential or actual flood conditions.
- Flood forecasting: A more definitive service based on simulation tools (e.g. statistical curves, level-to-level correlations or time-of-travel relationships) and modelling (see below), allowing a quantified and time-based prediction of water level, enabling flood warnings with an acceptable degree of confidence and reliability.

[3] http://www.unisdr.org/2006/ppew/info-resources/ewc3/checklist/English.pdf

- Vigilance mapping: A site-specific warning approach relying on map-based visualizations as an Internet service. The levels of risk derived from observations or from models are characterized by a colour code (e.g. green, yellow, orange, red) indicating the severity of the expected flood[4].
- Inundation forecasting: The most sophisticated and resource-intensive forecasting service and requires combining a hydrological or hydrodynamic level-and-flow model with digital representations of the flood plain land surface. Good quality models of this type can predict flooding at very precise locations, for example housing areas or critical infrastructure such as power stations and road or rail bridges.

The Nile Basin case study illustrates a multitude of different flood forecasting methods that are used by the Ministry of Water Resources and Irrigation in Egypt (see Box 1).

Box 1 Flood forecasting in the Nile River Basin (Egypt, Sudan)

Flood forecasting is essential for Egypt and other Nile basin countries for many reasons (both regarding hazard/risk aversion as well as the utilization of the Nile´s water). Different flood forecasting methods are used in Egypt to increase accuracy:

Watershed rainfall monitoring and forecasting is performed by rainfall satellite images (10 days lead time) (done by the Nile Water Sector, who also monitors gauging stations).

Climatic changes and Nile Basin rainfall indications are monitored through a flood forecasting and simulation center, which uses satellite images and hydrological models (done by the Planning Sector).

An overall estimation of the size of potential floods (and general water levels) is done by the High Aswan Dam Authority, using previous flow records to extrapolate the size of incoming floods.

Hydrological forecasting for one or more years is done by the Nile Research Institute, using statistical forecasting approaches (historical records are analyzed to propose and outline the future flow levels).

3.2 Elements of a viable flood forecasting and early warning system

Effective warning means a clear communication or clear line of communication and a fast reaction of the people to the warning, based on preliminary risk awareness and preparedness. A viable flood forecasting and early warning system for communities at risk requires a combination of good data/information sources, modelling and forecast tools and trained forecasters, proper and adequate communication and dissemination channels, as well as planned and customized responses. To provide effective warnings, flood forecasting and early warning must be focused on the communities and infrastructure within a river basin or other management area (city, district, region etc.), and should address, inter alia, emergency services (police, fire brigades, and in extreme cases, the military), civil defence or contingency managers, the media, affected economic sectors (such as agriculture, industry, hydropower and municipal water supply organizations), water resource and flood control authorities, NGOs involved in relief and rescue and the organizations responsible for

[4] As used on the webportal Meteoalarm (see http://www.meteoalarm.info/).

critical infrastructures (e.g. transportation, energy and in some cases priority individual premises, such as toxic waste storage sites).

Generally speaking, the main components of a national flood forecasting and warning system are the following:

- Collection of real-time data for the prediction of flood severity, including time of onset and extent and magnitude of flooding;
- Preparation of forecast information and warning messages, giving clear statements on what is happening, forecasts of what may happen and expected impact;
- Communication and dissemination of such messages, which can also include what action should be taken;
- Interpretation of the forecast and flood observations, in order to provide situation updates to determine possible impacts on communities and infrastructure;
- Response to the warnings by the agencies and communities involved;
- Review of the warning system and improvements to the system after flood events.

Hence, forecasting and early warning are multi-level tasks requiring clear responsibilities. It is necessary to integrate all the above mentioned management levels - both vertically from the transboundary to the local level, as well as horizontally by cooperating with non-government organizations and internally (i.e. between different government organizations) - into the system. Also, responsibilities in case of a hazardous event need to be clear und understood by all involved actors (see "Concept of Operation" in Section 3.3 below).

Box 2 Flood forecasting in the Ganges Brahmaputra Meghna Basins (Bangladesh, China, India, Nepal)

The Ganges Brahmaputra Meghna (GBM) Basins are shared by China, Nepal, Bhutan, India and Bangladesh as the lowermost riparian country, with a total area of about 1.72 million sq km. Bangladesh, being the lowermost riparian country of the GBM Basins, is the recipient of huge transboundary water flows from upstream countries as well as sediment loads. About 90% of the flood flows of Bangladesh enter via transboundary rivers (57 transboundary rivers in sub-basins enter Bangladesh, 54 from India, 3 from Myanmar), and during the monsoon period, floods cause huge loss of properties, lives and livestock and result in significant economic damage.

Flood forecasting and early warning systems as non-structural measures are being practiced in Bangladesh to enable and persuade people, communities, agencies and organizations to be prepared for upcoming floods and to take the necessary actions to increase safety and reduce damages to lives and properties. For giving a flood warning, the message is sent from the Flood Forecasting and Warning Centre) (FFWC) of the Bangladesh Water Development Board (BWDB) for broadcast to various news agencies, television stations, radio and through mobile phones to designated community centres. The warning system is implemented in the field with the help of public agencies like Bangladesh Meteorological Department (BMD), Department of Disaster Management (DDM), Department of Agricultural Extension (DAE), local communities and NGO's working in the flood-affected areas. A web-based flood warning system in Bangla (the local language) is also operational. There are some structure-based forecasts for important individual premises in various flood prone

areas and on highways. Flood warning dissemination through interactive voice response using mobile phone is becoming more popular and is used more regularly.

The present flood forecasting system forecasts with 3 day lead time (more that 80% confidence). 5-day forecasts are being implemented with acceptable confidence, and collaborative programs with regional integrated early warning systems (RIMES) for 10-day flood forecast are being tested and implemented with limited success. Research is on-going to forecast floodings during the monsoon in Bangladesh using satellite based data and information, but data from upstream river basins is sometimes difficult to obtain.

3.3 Requirements of flood forecasting and warning

Flood forecasting and early warning systems require a set of technical data that include hydrological data (river level and flow in general and specifically for forecast points and at-risk sites), meteorological data (rainfall data, weather forecasts and rainfall event warnings), topographic data (physical geographic definition of factors that affect runoff and may be required for certain models), and structural/socio-economic data (location of the population, at-risk sites, reservoirs and flood protection, power and transport infrastructure).

Such data then "feed" (hydrological) modelling and forecast tools, preferably at the catchment scale. The most commonly distinguished types of models are rainfall-runoff models or routing models, both types being used successfully for flood warning purposes. Usually, routing methods-based flood forecasting models are simpler and less data-intensive.

However, it is important to note that flood regimes change over time, especially if climatic changes are considered. It is therefore necessary to guarantee flexibility in the methods and approaches used for forecasting floods (i.e. statistical methods and models used), and in the flood forecasting system´s Concept of Operation (see below), if necessary.

The overall interactions between data, forecast technology and "users" (i.e. potentially affected people and organizations) should also be fixed in a so called "Concept of Operations”. A flood forecast and early warning system must provide sufficient "lead time" for communities to respond. As an example, the lead time for issuing flood warning in the Chindwin river basin in Myanmar is about one to two days advance for upstream of rivers and small rivers, and about three to five days for downstream of rivers, especially for deltaic area of Ayeyarwady (see Box 3 below; for another example of lead times, see the description of the Bangladesh case study above, in Box 2). Increasing the lead time enhances the potential for limiting damages and loss of life. At the same time, forecasts and warnings must be sufficiently accurate to promote community confidence (so that people will actually respond when warned). If forecasts are inaccurate, the credibility of the program will be questioned and there will be less/no response.

Also, the channels chosen for notifications/dissemination must be appropriate for the community at risk - first, it should also include information about what the public should actually do. Second, warnings via the internet certainly reach a significant percentage of people living in populated areas - in remote areas, however, a large number of people may not be able to receive warnings distributed via the internet (due to unreliable internet connections). Alternatives include warnings via local radio, appointed community wardens equipped with direct two-way radio and/or mobile telephone,

local means of raising alarms (e.g. church bells, sirens and loud hailers), and "sky shouts" from emergency service helicopters. Ideally, a combination of different channels - both public and private - should be employed (see description of the channels being used in Myanmar and Bangladesh in the case study descriptions).

As further reference, the WMO Manual on Flood Forecasting and Early Warnings[5] provides extended details about the requirements for setting up a flood forecasting and early warning system.

Box 3 Flood forecasting in the Chindwin River Basin (Myanmar)

In the Chindwin River Basin in Myanmar, daily river water level forecasts are issued for 30 hydrological stations along the eight major rivers of the country. The Department of Meteorology and Hydrology (DMH) then applies empirical models based on single and multiple regression analysis for forecasting peak flood level and daily river forecasting.

In case the water level of any station exceed a certain danger level, flood warnings are issued, resulting in lead times of one to five days, depending on the location in the river basin (one to two days advance for upstream locations and small rivers, and about three to five days for downstream locations like the deltaic area of Ayeyarwady). Forecasts and warnings are disseminated through different channels of communication, such as radio, television, newspaper, by telegraph, telephone and single band transceivers, mainly to the administrative authorities of the flood prone areas, but also directly to the impacted population. Depending on the severity of the event, the warnings are also broadcasted repetitively through Myanmar Broadcasting Services (TV and Radio).

3.4 Flood forecasting and early warning systems in a transboundary setting

In a transboundary setting, many of the necessities for a viable flood forecasting and early warning system are more challenging to implement. At the same time, the transboundary organization of such a system is of great importance, as major flooding events often have impacts in several riparian countries. Benefits of transboundary forecasting include:

- Knowledge on the flood formation processes can be shared and opportunities may arise to find better and more cost effective solutions.
- Cooperation helps to strengthen the knowledge and information base and enlarge the set of available strategies.
- Disaster management is highly dependent on early information and requires data and forecasts from the whole river basin, which can only be provided by transboundary cooperation and data sharing.

For transboundary flood risk management, and especially forecasting and early warning systems, the sharing of data is crucial. Data sharing, however, also needs to be stable (i.e. be continued over longer periods of time) and in real-time, but can trigger further institutional change and facilitate transboundary cooperation in other policy areas.

[5] http://www.wmo.int/pages/prog/hwrp/manuals.php

The main challenges for transboundary forecasting and early warning systems, which were discussed also at the UNECE´s first workshop on "Transboundary flood risk management" in 2009, include:

- Define information needs and joint information transfer: As stated above, for effective and efficient forecasting and early warning systems, it is essential to have in-depth knowledge of the functioning of the water system and the prevailing hazards and risks, at the basin scale. In a transboundary basin, basin-scale means "across borders" - hence, for being able to assess basin-wide information, common data/information format and a system for joint information transfer needs to be established. The challenge here lies in "harmonizing" often decades-old national practices in flood risk management (including different data/information formats), to render data/information and transfer channels compatible, and to draw up management objectives and list potential strategies for the river basin as a whole, to develop monitoring and information systems that are useful throughout the entire river basin (the case study of Myanmar demonstrates that information needs and joint information transfer are not always satisfactorily resolved even at the national level).
- Compatible systems and forecasting models: A similar challenge lies in the systems and models used to actually forecast a flood event - these are, of course, dependent on the available information, but for greatest effectiveness and efficiency, they would ideally also be compatible and comparable, which can be a specific challenge in a transboundary basin, where different technologies are used in different countries.

Transboundary flood risk management in general, and forecasting/early warning specifically, has both a technical and a political aspect. In some countries, technical cooperation is ahead of institutional and political cooperation, i.e. it is not the technical capacity that is missing for common/integrated flood forecasting and early warning systems, but rather its transboundary institutionalization, and vice versa (see Box 4 on the river Panj below). In other countries, key problems are related to financing (often expensive systems) and type of processes (very complicated referring to flash floods).

Box 4 Transboundary cooperation in the Panj river basin (Afghanistan, Tajikistan)

The Panj river basin is located in the high montane areas of Afghanistan and Tajikistan, reaching heights of 5,000 to 7,000 meters. Hence, glaciers and permanent snow fields play an important role in the hydrological regime of the Panj, and the periods of maximum runoff coincide with the intensive melting of snow packs in summer (June to August). Glacial lake outburst events and the rapid melting of snow cover are the main causes of flooding on the river.

The two countries cope with the dangers by cooperating: in 2014, the competent authorities of Afghanistan and Tajikistan signed a memorandum on the exchange of hydrological information, including prevention and cooperation on forecasting and river flows. The memorandum covers also joint research and evaluation, and the exchange of prognostic data and products. Also in 2014, an interstate hydrological station called "Ayvadzh" was constructed on the border of Afghanistan and Tajikistan, being currently tested.

The following example from the Prut river basin (Box 5) demonstrates successful cooperation regarding data exchange and shared management responsibilities.

Box 5 Data exchange in the Prut Basin (Romania, Ukraine, Moldova)

An excellent example for successful exchange of data in a transboundary river basin is the EAST-AVERT project in the basin of the river Prut, located in Ukraine, Romania and Moldova. For flood forecasting, information from the Hydrometeorological Service Centres of the Republic of Moldova, of Ukraine and Romania is mutually shared (organized by an agreement). Also, in shared water bodies, like the Costesti - Stanca, the water management is coordinated between specifically created management group on the Romanian side, and an "operating group" on the Moldovan side. In the Costesti - Stanca water body, all decisions on water discharge, power generation and other operational decisions are taken solely on the basis of mutual consultations. It is stated the main factor contributing to the success of such transboundary agreements as in the Costesti - Stanca water body is the understanding from both sides about the responsibility for possible negative consequences as a result of inadequate management.

3.5 Recommendations from the workshop

Data sharing is crucial: As recognized already at the 2009 workshop, the sharing of data is a crucial point in transboundary flood risk management, and especially important for forecasting and early warning. Data sharing, however, also needs to be stable (i.e. be continued over longer periods of time) and in real-time. To facilitate this, the WMO Resolutions 25 and 40 on the exchange of hydrological and meteorological data between NHMSs should be fully implemented in transboundary basins.

Flexibility in methods and data is necessary: flood regimes change over time, especially if climatic changes are considered. It is therefore necessary to guarantee flexibility in the methods and approaches used for forecasting floods (i.e. statistical methods and models used) and to enable the flood forecasting system to be revised.

Delivery of information: adequate response times are very important to properly prepare for a flood event, and delays need to be avoided - for this, early warnings should be provided by media and other public channels in parallel to the government´s channels. "New technologies" (like smartphones) should be utilized, considering, however, potential limitations (like internet access and literacy). Finally, the best early warning system is ineffective in case the population does not know how to respond. Hence, education and awareness about proper responses in case of an early warning is equally important.

Forecasting and early warning are multi-level tasks requiring clear responsibilities: For a forecasting and early warning system to function well, it is necessary to integrate all management levels - vertically from the transboundary to the local level, and horizontally by cooperating with non-government organizations - into the system. This, for example, means that community-based flood risk management needs to be aligned with transboundary approaches. Also, responsibilities in case of a hazardous event need to be clear und understood by all involved actors.

4. Flood risk management in transboundary basins

Flood risk management planning focuses on the reduction of potential adverse consequences of flooding for human health, the environment, cultural heritage and economic activity, on non-structural initiatives and on the reduction of the likelihood of flooding. To achieve this goal, flood risk management plans need to be developed to identify actions and measures to prevent and minimize the impacts of flooding. Flood risk management requires adopting a river basin approach to planning through multidisciplinary inputs in order to reduce flood vulnerability and risks and preserve ecosystems.

Box 6 Principles of flood risk management in the Danube River Basin (Austria, Bulgaria, Bosnia and Herzegovina, Croatia, Czech Republic, Germany, Hungary, Moldova, Montenegro, Romania, Slovakia, Slovenia, Serbia, Ukraine)

The Action Plan of the International Commission for the Protection of the Danube River has identified major principles for flood risk management planning: (i) the shift from defensive action against hazards to management of the risk and living with floods (ii) the river basin approach taking into account the EU Water Framework Directive, (iii) joint action of government, municipalities and stakeholders towards flood risk management and awareness raising, (iv) reduction of flood risks via natural retention, structural flood protection and hazard reduction, and (v) solidarity.

Comprehensive flood risk management is crucial to reduce flood risks. Tt consists of key components that include:

1) Prevention: Preventative flood risk management towards preparedness, including spatial planning, the setting of flood defence measures and alarm systems, awareness raising campaigns among the population, etc.
2) Response: Flood management during events, implementing, forecasting frameworks and early warning (as described in the previous chapter), flood measures and evacuation plans; and
3) Reconstruction: Post flood event management, which includes aid, support and cleaning activities as well as the implementation of an appropriate assessment process to identify eventual shortcomings in existing flood management activities and plan improvement.

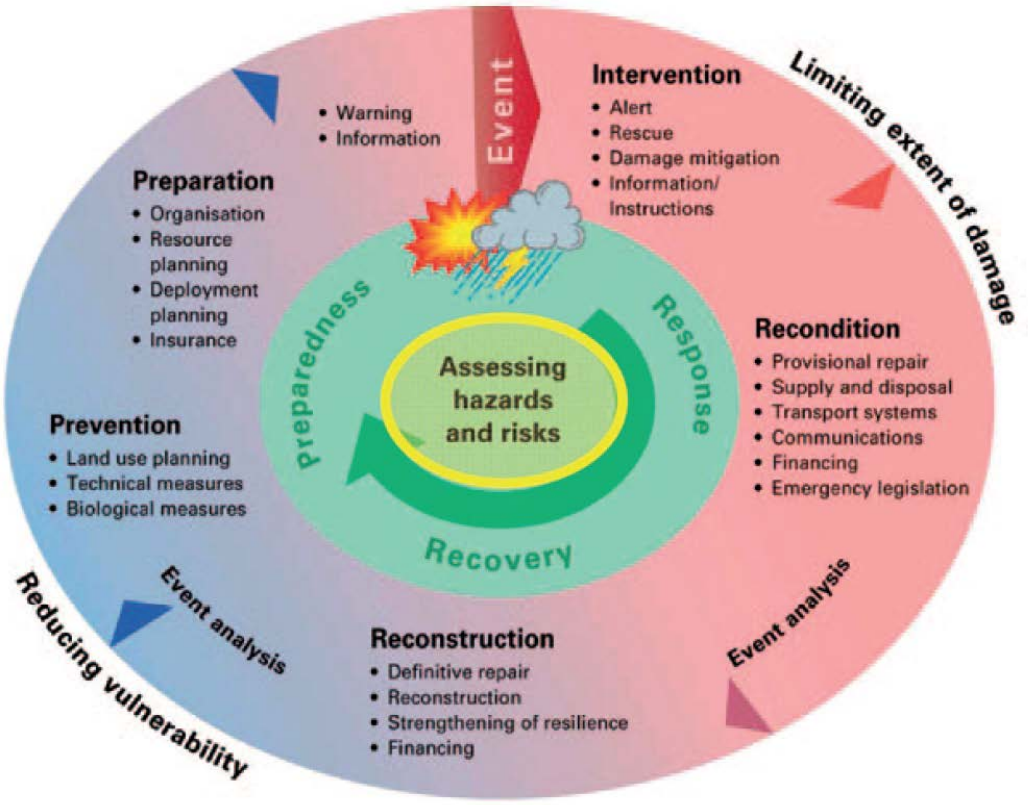


Figure 2 Flood risk management cycle[6]

According the UNECE Guidelines on Sustainable Flood Prevention[7], to facilitate transboundary management planning, it is important to draw up action plans outlining key activities to pursue sustainable flood risk management. To this end, the development of transboundary flood risk management plans represents an opportunity to lay down the foundations of action.

Box 7 UNECE Guidelines on Sustainable Flood Prevention

When developing good management practice, joint authoritative bodies of transboundary water bodies should:

- Draw up a long-term flood management strategy that covers the entire transboundary river basin and its entire water system rather than the transboundary watercourse as such; therefore effectively integrating land and water resources management

- Include in the strategy at least such major objectives as reduction of the risk to health and optimization of net benefits (included, but not limited to, damage to property); reduction of the magnitude of flood hazards; increase of flood risk awareness; and the setting-up or improvement of flood notification and forecasting systems;

- Draw up an inventory of all structural and non-structural measures to prevent, control and reduce floods; analyse the existing scope of flooding and human activities based on a risk analysis that goes

[6] http://www.secom20.eu/floods/flood-risk-management
[7] http://www.unece.org/fileadmin/DAM/env/water/publications/documents/guidelinesfloode.pdf

beyond national borders in the catchment area; and identify the inadequacies of the existing scope of the technical and non-technical flood control and preventive measures;

- To achieve the long-term goals of flood-related risk management, draw up an action plan that contains all the measures (as well as their costs and effects) that came up as a result of the review and have been ranked according to their relative importance and timetables.

Similar to the UNECE Guidelines, the EU Floods Directive calls for Member States (and their transboundary neighbours) to carry out the following tasks:

1. Undertake a preliminary flood risk assessment of their river basins and associated coastal zones to identify areas where potential significant flood risk exists.
2. Develop flood hazard maps and flood risk maps for such areas. The flood hazard maps identify areas with a medium likelihood of flooding (1 in 100 year event), as well as extreme events and areas with a high probability of floods. Flood risk maps include information on number of inhabitants potentially at risk, damage to economic activities and the environmental damage potential for the three flood scenarios (high, medium and low probability of flooding).
3. Draw up flood risk management plans for flood risk zones. These plans are to include measures to reduce the probability of flooding and its potential consequences (on human health, the environment, cultural heritage and economic activities). They will address all phases of the flood risk management cycle but focus particularly on prevention, protection and preparedness.

Section 3 of this report clarified the need for gathering data for flood forecasting; the same data are the key basis for carrying out a flood risk assessment, which serves as the starting point for flood risk management. In order to better define where action should be taken, in transboundary river basins joint mapping should further pin point where joint activities and measures can take place. The development of a transboundary flood risk management plan should contain all these points in order to provide a solid framework for cooperation.

4.1 Joint mapping

Knowledge of hazards and risks, in particular their spatial distribution, is at the core of effective flood risk management planning. The development of flood hazard and also risk maps is one of key prerequisites to an efficient flood risk management. Flood hazard maps show the potential impact of a flood, i.e. the extent, expected water depths/levels and, where appropriate, the flow velocity or water flow. They should reflect three scenarios: a low probability scenario characterised by extreme events (likely return period = 1000 year), a medium probability scenario (likely return period ≥ 100 years) and a high probability scenario (ranging from a likely return period = 10-20 years). Flood risk maps provide essential information to the public but are also important tools for planning authorities and the insurance industry. The flood risk maps should increase public awareness of the areas at risk of flooding. They should provide information of areas at risk by defining flood risk zones to give input to spatial planning and should support the processes of prioritizing, justifying and targeting

investments in order to manage and reduce the element at risk (such as to people, property and the environment).

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 country considers useful. In the EU for example this is information on environment and cultural heritage.

Maps must be easily readable and show the different hazard levels. They are necessary for the co-ordination of different actions, especially in the transboundary setting. Flood maps are used by various stakeholders for various purposes. As maps are primarily used to identify risk areas, they can help to reduce existing risks, adapt to changing risk factors and help to prevent the build-up of new risks (planning and construction)[8].

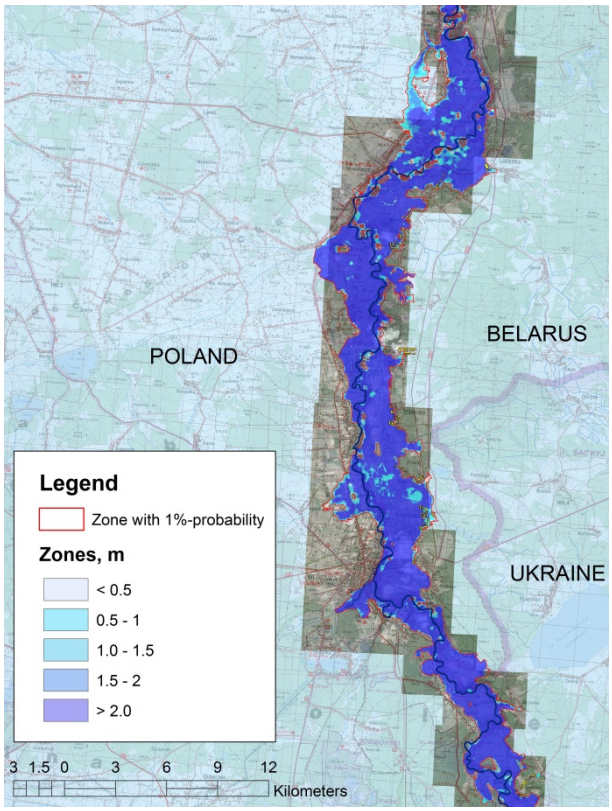


Figure 3 Combined Flood Hazard Maps and Flood Risk Maps for the pilot district of the river Bug[9]

[8] 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

[9] Prepared by Aliaksandr Pakhomau and Vladimir Korneev

Transboundary flood maps serve basis for investigating and discussing cross-border effects and impacts of flood control measures. Benefits of transboundary maps include[10]:

- *Cost-efficiency*: Producing one common flood map can be more cost efficient than producing separate maps for both sides of the border.
- *Improved cooperation*: Common flood maps, along with common early warning systems, can facilitate actions during emergency situations.
- *Good starting point*: Transboundary flood maps can provide a common basis for an integrated cross border approach of flood risk management, spatial planning and nature conservation and development.
- *Strengthening cooperation:* The process of developing a common trans-boundary flood map may strengthen trans-national cooperation and exchange between responsible authorities and may help to increase mutual confidence.

Box 8 Flood risk mapping in the Bug River (Poland, Belarus, Ukraine)

Flood Hazard Maps (FHMs) and Flood Risk Maps (FRMs) for the Bug River with compliance with EU Flood Risk Management Directive were developed for the first time in the frame of FLOOD-WISE Project. Therefore, a common approach (Poland, Belarus and Ukraine) was used for the floods modelling and mapping based on the next suggestions:

- All Bug countries (Poland, Belarus, Ukraine) are using the same system of terrain heights (Baltic System);
- To prepare FHMs and FRMs for pilot Bug river basin district area for scenarios 1% (once per 100 years), 5% (once per 20 years); 10% (once per 10 years);
- To use hydraulic method for modelling based on 1D Saint –Venant generalized equations;
- To use hydrological data from Poland, Belarus and Ukraine;
- To use morphological data including existing cross sections coordinates (from Belarus) and general description of the cross section of the Bug river for the Polish territory;
- To use GIS modelling with using public data (map with scale 1:50000) and data sets on the WEB (map of Wlodawa town with scale 1:25000 and 1:10000, free satellite DEM, CORINE land use data base etc.);
- To take into account existing good practices regarding methodology and technology of the preparation of a Flood Risk Maps and Flood Hazard Maps i.e. LAWA method etc.

On the basis of the need to enhance the natural flood retention capacity of the Amur floodplains and other wetlands, China and Russia[11] have realized that a joint effort is needed to create transboundary GIS map of major river valleys, including all transboundary watercourses. Key steps identified in the Amur Basin for developing a common flood map between China and Russia include:

- Develop maps of floodplains, areas flooded with a return period of 200, 100 and 10 years.
- Conduct professional exchanges on floodplain land-use regulation and development of flood-retention areas.

[10] 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

[11] Case Study submitted to the workshop

- Identify floodplain water retention areas that are the most important for reducing flood risks.
- Evaluate already achieved reduction in natural flood-retention capacity and risks of further reduction due to water infrastructure development and other human-induced and natural factors.
- Cooperate on strategic environmental assessment of flood-management plans.
- Develop joint comprehensive program for preservation and enhancement of flood retention capacity of floodplains
- Identify floodplain complexes of high value that should be added to transboundary network of protected areas.

Although in most countries the level of expertise is sufficient to deal with flood-related issues, expertise in producing flood risk maps varies significantly. 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. Developing flood maps requires a systematic process. It is important to specify the datasets on which the maps will be based and the methodology that will be used. In addition, administrative mechanisms are necessary to develop flood mapping programmes. The IFM Tool on Flood Mapping[12] provides guidance to undertake flood mapping exercises for the various planning processes on local or national level which cover issues like changing land uses and climate change, land use regulations and building codes, impacts of urbanization, emergency response, asset management, flood insurance, or overall public awareness.

4.2 Flood risk Management plans

Flood risk management plans play an important role in the preparedness and prevention of flood-prone areas. Their development helps to flesh out more specifically the objectives of a particular basin. Flood Risk Management Plans should highlight the hazards and risks of flooding from rivers, the sea, surface water, groundwater and reservoirs, and set out how Risk Management Authorities work together with communities to manage flood risk.

Box 9 Focus of the EU Flood risk management plans

In the EU, Flood Risk Management Plans should include measures to reduce the probability of flooding and its potential consequences. They address all phases of the flood risk management cycle (see figure 2) but focus particularly on prevention (i.e. preventing damage caused by floods by avoiding construction of houses and industries in present and future flood-prone areas or by adapting future developments to the risk of flooding), protection (by taking measures to reduce the likelihood of floods and/or the impact of floods in a specific location such as restoring flood plains and wetlands) and preparedness (e.g. providing instructions to the public on what to do in the event of flooding). Due to the nature of flooding, much flexibility on objectives and measures are left to the

[12] http://www.apfm.info/?portfolio=flood-mapping

Member States in view of subsidiarity. However there is a requirement that the Member States shall establish flood risk management plans coordinated at the level of the river basin district (Art 7(1)).

The basis for flood management plans should be action plans developed jointly by all countries in the transboundary basin. An action plan should lay out the way forward and the key steps needed in order for flood risk countries to cooperate. Coordinated actions will improve cooperation and coordination of flood risk management objectives and measures at river basin level, allowing also for coordination development and promotion of practice among the transboundary neighbours.

Box 10 Action Plan on Floods in the Danube River Basin (Austria, Bulgaria, Bosnia and Herzegovina, Croatia, Czech Republic, Germany, Hungary, Moldova, Montenegro, Romania, Slovakia, Slovenia, Serbia, Ukraine)

In response to the danger of flooding the International Commission for the Protection of the Danube River (ICPDR) adopted the Action Programme on Sustainable Flood Protection in the Danube River Basin in 2004. The goal of the Action Programme is to achieve a long term and sustainable approach for managing the risks of floods to protect human life and property, while encouraging conservation and improvement of water related ecosystems. Given the area, the complexity and the internal differences in the Danube River Basin, the Action Programme represents an overall framework, which needs to be specified in further detail for sub-basins. 17 flood action plans for all sub-basins in the Danube catchment area were prepared in 2009.

The action plans for sub-basins review the current situation in flood protection in the respective river catchments and set the targets and the respective measures aiming among others to reduction of damage risks and flood levels, increasing the awareness of flooding and to improvement of flood forecasting. The measures are based on the regulation of land use and spatial planning, increase of retention and detention capacities, technical flood defences, preventive actions, capacity building, awareness & preparedness raising and prevention and mitigation of water pollution due to floods.

Agreed prior to the adoption of the EU Floods Directive, the Danube Flood Action Programme and its plans are closely aligned with the requirements of the directive. The Flood Protection Expert Group of the ICPDR analysed the requirements between the two documents, resulting in extending the scope of protection or management of risk to human health and economic activity as these were not explicit in the Action Programme. The biggest difference between the two was the timing, with the action plans prepared 6 years prior to the EU flood risk management plans. The work under the action plans served as the basis for implementing the EU Floods Directive.

Flood management planning should follow the basic cycle for integrated water resource management, as shown in Figure 4 below.

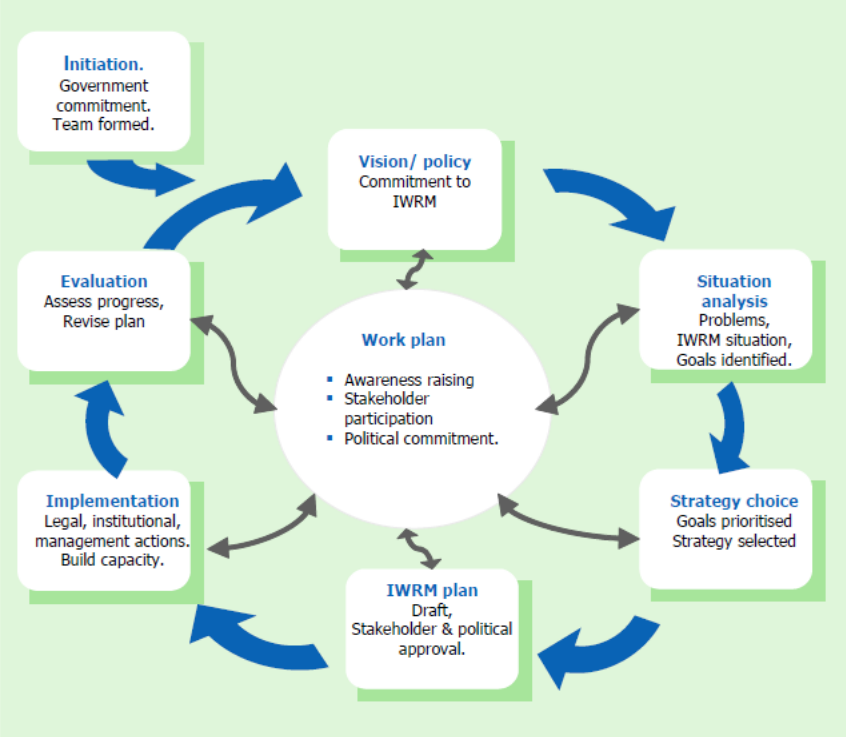


Figure 4 Planning cycle for development a flood risk management plan[13]

The first step, if not already established, is to set up a core team of experts from key authorities affected by flood events (e.g. water resources, agriculture, environment, disaster risk, transportation, etc.). Key stakeholders should be identified. Together with the core team, the overall objectives for flood risk management should be developed from the start in order to steer the policy process. Using data gathered (e.g. through monitoring and forecasting activities, a flood risk assessment should be carried out, outlining the problems. Following this, a strategy should be drafted together with stakeholders. Measures and options for achieving objectives should be defined (see section 4.3). These elements should form the basis for the management plan.

Considering good practice, flood risk management plans should include:

- a map showing the boundaries of the Flood Risk Area
- the conclusions drawn from the flood hazard and risk maps
- objectives for the purpose of managing the flood risk
- proposed measures for achieving those objectives
- a description of the proposed timing and manner of implementing the measures including details of who is responsible for implementation
- a description of the way implementation of the measures will be monitored
- a report of the consultation

[13] WMO (2007): Formulating a Basin Flood Management Plan. A Tool for Integrated Flood Management Available at: http://www.apfm.info/publications/tools/Tool_01_Basin_Flood_Management_Plan.pdf

- where appropriate, information about how the implementation of measures will be co-ordinated

Potential ways to harmonize flood risk planning methods across the border include (with respect to the requirements of the EU Flood Risk Management Directive if appropriate):

- Forming bilateral or trilateral river basin committees would be a good suggestion and platform for increasing efficiency of flood risk management as well as water resources management including different levels of cooperation, improvement of data exchange, coordination of border measures;
- Exchange of meteorological, hydrological data and data about water quality (chemistry and hydrobiology) on regular basis (at least as once per year);
- Provision of information and cross-border exchange of data in on-line regime in case of emergency situation e.g. of floods, accidental pollution etc.;
- Implementation of the international projects on detail specification of the flood Risk maps and flood risk management plan for the entire transboundary river district based on more detail cartographic information and common hydrological and hydraulic model;
- Implementation of the International project on prototype of Early Warning System development with installation of Automatic Hydrometeorological Stations (AHS).

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.

Box 11 Flood risk management plans in the Rhine River Basin (Austria, The Belgian Region of Wallonia, France, Germany, Italy, Liechtenstein, Luxemburg, Netherlands, Switzerland)

The International Commission for the Protection of the Rhine (ICPR) started in 2010 to draft the 1st FRMP for the International River Basin District (IRBD) Rhine, based among others on the state of implementation of the Action Plan on Floods by 2010. The draft FRMP respects some very important subsidiarity and solidarity principles “upstream-downstream” and “tributaries-main stream” and contains common goals and measures for flood risk management. The draft FRMP is available in German, French and Dutch since December 22th 2014 for public information and consultation according to the FD. The FRMP will be finalized and available in English by December 22th 2015.

Box 12 Flood risk management plans in the Tisza River Basin (Hungary, Slovakia, Romania, Ukraine)

The first Ukrainian national experience with respect to introducing the complex approach for flood run-off management was adopting the State comprehensive programme targeting complex flood protection activities at the Tisza river basin, launched in 2002. The Programme entirely corresponds to the EU water management policy. Its activities are being coordinated with the Tisza river basin neighbouring states: Hungary, Slovakia and Romania, and their realization will contribute to the flood protection improvement in these countries, especially in Hungary. The Programme provided for the three basic directions to be implemented: modern flood run-off management methods with active and passive management approaches, automated forecasting of the flood threats, basin water resources management approach providing for the high priority of the flood protection system.

At the end of March 2013 a Joint Ukrainian-Hungarian flood protection development programme was elaborated. It is based on the approved joint flood surface profile and meets the national legal

norms of the Parties, includes previous researches and elaborations, is connected with the structures built at both sides of the border during the last years and corresponds to the EU Flood Directive principles. The Development Programme was recently approved by the 5th Priority Steering group of the Danube Macro-regional Strategy and by the Government Commissioners of Ukraine and Hungary.

4.3 Flood risk management Measures

To help manage floods, risk reduction measures are a critical component of (transboundary) flood risk management plans. Such measures can be:

a. *Structural measures* are those actions that require physical constructions like:
   - Existing dikes improvement for protection against floods and new dikes disposal for flooded urbanized and rural areas;
   - Bank protection – to reduce erosion;
   - Watercourses cleaning: clearing channels small rivers and large channels from silting; and
   - Implementation of flood storages to increase water retention capacities of the landscape.

b. *The non-structural measures* actions that do not require physical constructions. They include:
   - Building codes;
   - Land use planning laws and their enforcement;
   - Research and assessment;
   - Information resources;
   - Public awareness programmes; and
   - (previously mentioned) flood forecasting and early warning systems.

Cooperation across borders requires a permanent effort of coordination and communication in order to establish common objectives and financial allocations. A big challenge is to reduce the flood peak in the upstream area and to reduce the hazard in the lower part of the catchment. This is needed at several levels: internally, between specialists and authorities controlling contracts and outward by informing and educating elected officials, funders and users to become strong partners. These efforts must be supported by a determined political will to generate means of implementation.

In the past, hard defence measures have been touted as particularly critical for flood management. The construction of reservoirs and protection dikes have been commonly implemented as both measures change the flood characteristics: reservoirs retain and dykes accelerate the flow, thus both measures have transboundary impacts. Downstream effects depend on the situation and the characteristics of the flood.

Box 13 Flood prevention measures in the Dniester River Basin (Ukraine, Moldova)

So far, the main measures for flood protection in the Dniester Basin are reservoirs and levees system. Two reservoirs are constructed on the Dniester River Bed: first is Novodnesrtovsk which is managed by Ukraine and second is Dubasari situated within the Republic of Moldova territory. Both reservoirs are situated in the Middle Part of the basin and are constructed for multipurpose and played an important role in reduction of consequences of the 2008 flood event. Generated maximal discharges of the Dniester River exceeded 5410 m^3/s at Zalishchyky post (situated upstream Novodnesrtovsk

reservoir and representing natural flow) and 3400 m^3/s at Hrusca gauging station (situated upstream Dubasari reservoir) which is 10 times bigger than the average.

In recent years there has been a trend towards emphasizing structural measures less impacting on the natural river behaviour and morphology, i.e. ecosystem measures like natural water retention measures. Also the EU has flagged the establishment of natural water retention measures as a top priority.

In other regions there are similar trends, for example from 2003-2012 there has been a widely welcomed policy shift toward greater balance between structural and non-structural measures in flood management in the Amur Basin. Nevertheless up to 60% of proposed budgets in the newly designed "Integrated Scheme for management and protection of water bodies"(2014) have been earmarked for dykes and embankments.

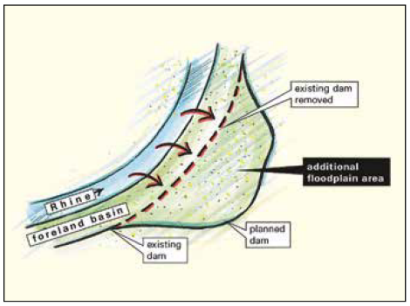
Box 14 Flood risk measures between France and Switzerland

The Franco-Geneva transboundary waters action program was established with the aim for the restoration and enhancement of aquatic environments covering the entire watershed. The agreement helped implement practical management of transboundary waters.

In the watershed Marquet-Gobé-Vengeron, three retention ponds were built between 2005 and 2008, two located on French territory and one in Switzerland. The retention capacity created at the three sites is equal to 60,000 m^3. These achievements have helped protect urbanized areas downstream against flooding. Another example is the protection of the Swiss village of Hermance that sits along the river that serves as a national border, with a Swiss bank heavily urbanized and subjected to flooding and a more natural French bank. In the context of cross-border agreements, it was possible to expand the French bank to earn hydraulic capacity and protect the Swiss residential areas against flooding.

Box 15 Flood risk measures in the Rhine River Basin, Delta Region the Netherlands

In the Rhine delta, measures have been implemented to enlarge the river bed (Room for the River); this contributes to reduce flood peaks and flood risks. In addition, renaturalizing measures along tributaries and smaller waters in the catchment have been carried through. Due to the effects of climate change and the expected increase of the number of flood events and also considering the possibility of a greater probability of extreme events (see the work of the ICPR in this field here), in particular supra-regional flood risk management measures will become increasingly important.



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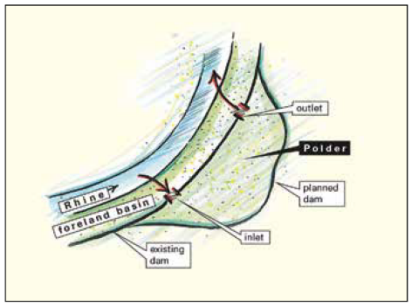
Relocation of dikes:
Relocate a dike further inland and thus regaining foreshores giving more room to the river.



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Flood retention polder:
Retention polders are areas which may be flooded in particular cases (targeted flooding). In that case, the Rhine water flows through the polder and, with a certain delay, back into the Rhine through a discharge structure.

An important element in the selection of measures is stakeholder participation. Effective public participation in decision-making enables the public to express, and the decision-maker to take account of, opinions and concerns that may be relevant to those decisions, thereby increasing the accountability and transparency of the decision-making process and contributing to public awareness of environmental issues and support and ownership for the decisions taken. Integrated Water Resources Management (IWRM) principles in this case mean that selection of flood protection measures should be organized taking into account water management options and trade-offs regarding upstream/downstream needs, hydro-energy/flood protection, flows to estuarine marshes/water quality, agriculture/water supply under a variety of climate scenarios.

Box 16 Integrated flood control in the basins of the Dniester, Prut and Siret (Ukraine, Moldova)

The Programme on integrated flood control in the basins of the Dniester, Prut and Siret rivers proposed an integrated approach using active methods of flow management with the passage of floods through various flood tanks (polders) and traditional measures against floods: levees, control beds of rivers, banks consolidation etc. The main task of the Programme was to find the optimal mix of methods for individual rivers and for the basin. Most of these measures are very costly which creates problems in finding funds for their implementation. The main problem with the proposed Flood Protection program, however, is that it was developed without involvement of other stakeholders (hydropower energy authorities, local authorities, academia, NGOs) from Ukraine and no stakeholders at all from Moldova. This resulted in the biased approach to propose only very costly measures within the water management sector only.

4.4 Recommendations from the workshop

Flood maps are a useful basis for management: Such maps[14] provide publicly available information on flood risks and potential damages to properties and the environment. Maps should be developed by public administrations with the necessary access to available data.

[14] See http://ec.europa.eu/environment/water/flood_risk/flood_atlas/

Climate change will influence the frequency, magnitude and "type" of flooding: There is an increasing need to include climate change into *(*transboundary) planning approaches to enable adaptation to increasing risks.

Flood risk management cannot stand alone: Flood risk management plans should not be developed in a vacuum. They should be linked to terrestrial and coastal spatial management plans to ensure that future development takes into account flood risks. Flood protection should also be linked to with ecological/ recreational objectives.

One option does not fit all: It is important to find the best mix of structural and non-structural measures, e.g. structural measures to protect urban areas combined with emergency planning and flood proofing.

Hazards and risk cannot be completely negated, but managed and thus, reduced: Exposure and vulnerability to floods can be reduced through structural and non-structural measures. It is important to mix structural and non-structural measures, but it has to be clear that despite the implementation of technical measures residual risks will remain.

Creation of water retention areas can be beneficial also for environmental protection. Natural water retention measures are multi-beneficial by creating enough natural space to retain flood waters but also serve at important habitat areas for biodiversity and contribute to the overall health of a river's flood regime by reducing the need for hard defence measures like damming.

Identifying flood risk measures is important but political/technical/operational issues still need to be solved. Political willingness to address the issue is paramount to receiving enough attention to be included in national budgets and capacity to develop technical measures and implementation is needed to ensure the right measures are taken up in the right places within a catchment.

Cost sharing of measures: Sharing the costs of measures among neighbours enables transboundary cooperation on projects. By carrying out projects together, the mutual benefit of measures can be better communicated with all interested parties. Sharing the financial burden for flood measures is one approach to facilitating ownership of reducing flood risks. **Co-financing at the transboundary level should be considered (when applicable).**

Promote incentives and/or risk sharing mechanisms (i.e. insurance). Despite measure implementation, residual flood risks will remain**.**

5. Institutional arrangements in transboundary basins

5.1 Introduction to institutional arrangements

Floods have no political borders as rivers flow through various basin countries from their source to their mouth; they have neither national nor regional or institutional boundaries. Therefore, flood management calls for interaction between various disciplines, government and various sectors of society. There is a need to overcome sector based 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, three elements can be distinguished:

- Legal setting and Policy arrangements: National laws, regulations, directives and international agreements and treaties, e.g. the UNECE Water Convention, together form the legal framework; Policies, policy intentions and plans that influence flood (and water) management on various governmental levels.
- 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. Here, in some countries community based participation facilitates important information arrangement for informing local inhabitants of flood risks and management decisions.
- Coordination mechanisms: working groups tasked with the technical operation

Box 17 The European Floods Directive

The EU Floods Directive entered into force in 2007 and aims to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity. It covers flooding in rivers, lakes, flash floods, urban floods, coastal floods as well as includes storm surges and tsunamis.

The Directive has to be implemented in three stages. Firstly, the Directive requires Member States to first carry out a preliminary assessment to identify the river basins and associated coastal areas at significant risk of flooding. The assessments have to take into account both observed past occurrences of flooding and long-term developments such as climate change. They include descriptions of past flood events and their adverse consequences as well as assessments of potential future floods and their impacts on human health, environment, cultural heritage and economic activity. In international river basins, the work needs to be coordinated across borders between the respective countries sharing a river or other water body basin. As of June 2013, 26 EU Member States have submitted the Preliminary Flood Risk Assessments. By far the most frequent type of flooding reported are fluvial floods. All EU Member States reported human health, environmental, economic and cultural consequences of floods.

In the second stage, Member States drew up flood risk maps for the zones identified as being under significant risk of flooding. The maps are to show the areas which could be flooded with high probability, medium probability (once every 100 years or less) and also with low probability or in case of extreme events or scenarios. Currently in the third stage of implementation of the EU Floods Directive, Flood Risk Management Plans (FRMP) have to be established by the end of 2015 focusing on prevention, protection and preparedness. The FRMPs are prescribed to include objectives of flood risk management and the prioritized measures to achieve those objectives. The FRMPs may include such measures as flood forecasts, early warning systems, sustainable land use practices, improvement of water retention as well as the controlled flooding of certain areas in the case of a flood event among others. The measures need to be aligned across borders so as to not cause damage to countries up or downstream in the same basin.

5.2 Elements of transboundary institutional arrangements

Legal setting

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.

Water conventions play an important role, as they represent the international legal framework of reference and support countries through capacity-building activities, basin-specific projects and the elaboration of guidance documents. A step-by-step approach to gain political support is needed. The UNECE Convention requires that parties cooperate in research and development and that they exchange information on water quantity and quality. Parties are required to establish a joint monitoring institute 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 through concerned institutes to provide forums for discussing planned flood prevention measures and agreeing on possible joint measures.

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.

Box 18 Legal arrangements in the Chad Basin (Chad, Cameroon and Niger)

The management and Action plan integrated of the water resources of the Charter of the water of the Commission of the Basin of the Lake Chad (CBLT) was adopted at the time of the 14th Summit of the Heads of State and Government on April 30, 2012 in Ndjamena and was ratified by Niger, Chad and Cameroun. The general objective of the program is to ensure a durable and equitable management of water resources within the framework of policies and national strategies of development and subscribed international engagements.

Article 40 of the charter of the water of the Commission of the Basin of the lake Chad (CBLT) lays down specific measurements for the prevention of the floods and their management:

Each State Party, insofar as it is concerned with the risk of flood by the Lake or its tributaries, or insofar as its geographical position enables him to take part in the forecast of this risk, begins with:

a) to inventory and chart the risk, the vulnerability and the risk of the zones potentially subjected to floods on its territory;

b) to inventory, in a data base, remarkable floods and returns

of experiment on the management of these events;

c) to develop and maintain a system of forecast and alarm including/understanding of the pluviometric and hydrometric stations;

d) to prepare Plans of Safeguard intended to define the actions to be led in the event of crisis of alarm.

Organizational settings

The achievement of integrated flood risk management in river basins is highly dependent on the organizational setting, within country boundaries as well as crossing boundaries. From a national perspective, integrated flood risk management requires that various roles are played by a complex set of actors to ensure cooperation and coordination across institutional and disciplinary boundaries (Figure 5). At various governmental levels (national, regional and local) decision-making requires coordination such that decisions take account of any impacts on flood management. Integration is therefore needed horizontally (i.e. between the different governmental departments and agencies and all relevant stakeholders) and vertically (i.e. at all governance levels from local, regional to national and transboundary). At the local level, community based management have proven to be an effective platform for enabling community participation in flood management decisions. Community flood management committees or other groups are helpful throughout the flood management cycle (Figure 4) by assessing needs of their communities, making provisions for emergency situations, raising awareness and management information, facilitating training and capacity-building and interfacing with government institutions[15].

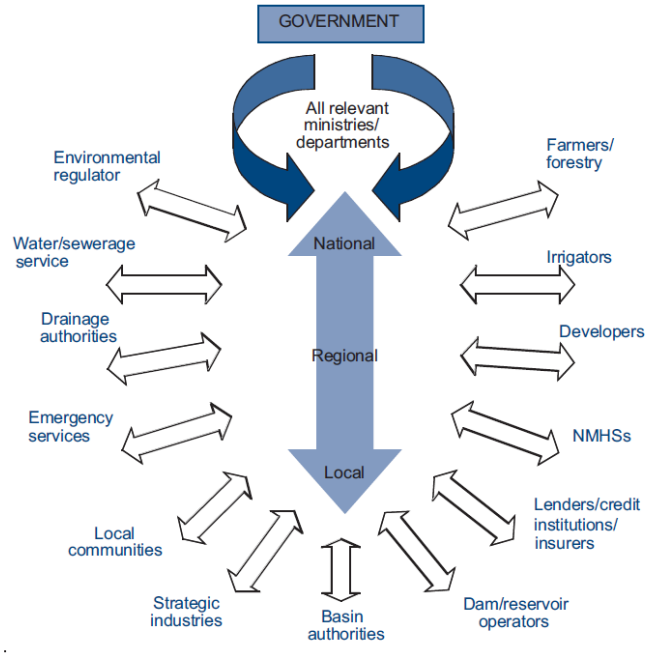

Figure 5 Integration of the various stakeholders and interest groups in flood management[16]

Transboundary communication is essential for cooperation. Different perceptions of the problems among riparian countries are an obstacle, and should be overcome through communication, joint studies and monitoring and exchange of data and information. In addition, bi- or multi-lateral

[15] WMO/GWP (2007): Organizing Community Participation for Flood Management – Tool 04.

[16] http://www.apfm.info/publications/policy/ifm_legal_aspects/Legal_and_Institutional_Aspects_of_IFM_En.pdf

agreements are possible through fruitful dialogue and exchange meetings between the governments. There are few examples of success and many examples of failures due to lack of interests from the relatively advantaged upstream countries and lack of political will. Institutions like River Basin Organizations (RBO's) of Transboundary Rivers, for example the International Commission for the Protection of the Rhine or the Danube, can fruitfully work for flood management in the river basin.

Box 19 Cooperation between Ukraine and Moldova

As part of an agreement between Moldova and Ukraine, a bilateral commission is envisioned to promote the sustainable use and conservation of the basin. The signing of this document is an important step in the implementation of Ukraine and the Republic of Moldova with its obligations under the UNECE Convention on transboundary waters, which has not yet been ratified. Increased cooperation of the two countries, including the development and approval of the agreement, was supported by the initiative "Environment and Security" (ENVSEC) through a number of projects conducted jointly by UNECE, the Organization for Security and Cooperation in Europe (OSCE) and the Program for United Nations Environment (UNEP). The signing of the Treaty is the result of the gradual development of cooperation over the last eight years with a wide range of stakeholders in both countries, including the Transnistrian region of Moldova.

Bilateral issues relating to the use and protection of water resources are considered in the framework of an agreement between the governments of Moldova and Ukraine on the protection and use of transboundary waters. Both countries meet regularly to address common issues, working under the auspices of several working groups, including the crucial issues of information exchange (except for water information which is organized through regular exchange of data on water quality in border cross-sections). However, the mechanism of implementation of the agreement is not explicitly designed to address watershed issues outside the border areas.

For the overall development in flood management sector, cooperation is essential to strike a balance between the different needs and priorities and share this precious resource equitably, using water as an instrument of peace. Dialogue should act as triggering instrument for initiation and building up consensus for water cooperation in this region. Formulation of Win-Win Situation should be ensured by both the countries by agreement of the political level on a common agenda and mobilizing public opinion.

Coordination mechanisms

A wide range of co-ordination mechanisms can be employed to facilitate coordination among authorities. These include[17]:

- Formal legal obligations, i.e. where relationships among authorities are defined by law;
- Inter-ministerial committees;
- Co-ordination undertaken by the main Floods authority; and
- Steering groups and advisory bodies.

[17] WRc (2012): Comparative Study of Pressures and Measures in the Major River Basin Management Plans, Task 1 Governance.

Box 20 Working Group between Mexico and USA in the Tijuana River Basin

Cooperation between Mexico and USA on transboundary issues of the Tijuana River Basin will be through Minute 320 of the International Boundary and Water Commission (IBWC), which was created by both countries to establish the boundary of each country and to comply, between others, with Treaty between The United States of America and Mexico, signed on 1944.

Implementation of this initiative will be as follows:

A Core Binational Group (CBG) will be established, designated and coordinated by the IBWC, which shall recommend measures for joint cooperation, taking into account previous work and advice of stakeholders in Mexico and the USA. The CBG shall be composed of representatives of IBWC, federal, state and local governments and a representative of NGOs in each country. The CGB will establish Binational Working Groups that will include staff from both countries required depending on the characteristics and nature of the work and within their attributions.

By exploring opportunities for coordination and joint cooperation, those that are of benefit to both countries and promote the sustainable management of transboundary resources in the Tijuana River Basin will be promoted.

Box 21 Cooperation activities between transboundary countries of the Drin River Basin (Albania, Former Yugoslavian Republic of Macedonia, Montenegro, Kosovo and Greece)

In December 2009 Drin Dialogue was launched and a shared mission for the basin was agreed among riparian countries. That was the first time that management of the basin was considered in a regional level. Nevertheless flood management was brought into the focus of regional discussion with the signature of the Memorandum of Understanding for the Management of the Extended Transboundary Drin Basin, by Ministers responsible for water resources and environmental management of the Riparians. This MoU was signed in Tirana on 25 November 2011.

From 10-11 September 2012 a round table was organised in Tirana with representatives of Ministries of Environments of the 4 countries and Hydrometeorolocigal institutes of all 4 countries as well as foreign experts from the DG Joint Research Center, World Meteorological Organisation and hydropower companies in Germany were also invited in the round table. It served as a start-up activity for the establishment of the Flood Early Warning System in Drin Basin.

A series of expert missions in all 4 countries of the Drin/Buna basin are organised during November – December 20102 to identify the gaps of the national hydro-meteorological services to properly deal with an flood early warning system and their needs to set it up were identified and recommendations developed.

A workshop was held in Tirana on 12-13 February 2013 and it was co-organised by the Albanian Ministry of Environment, Forest and Water Administration and Albanian Institute of Geosciences, Energy, Water and Environment. More than 40 experts in the fields of hydrometeorology and disaster management from the region shared their views and opinions on the presented gap analysis and the proposed ways of establishing EWS.

A range of joint activities can be carried out to improve transboundary flood management (Figure 6):

- The preparation of shared visions; the identification of flooding issues; monitoring programmes and activities;
- Shared databases;
- Shared management plans;
- Cooperation on measure implementation;
- Public participation activities; and
- Financial cooperation.

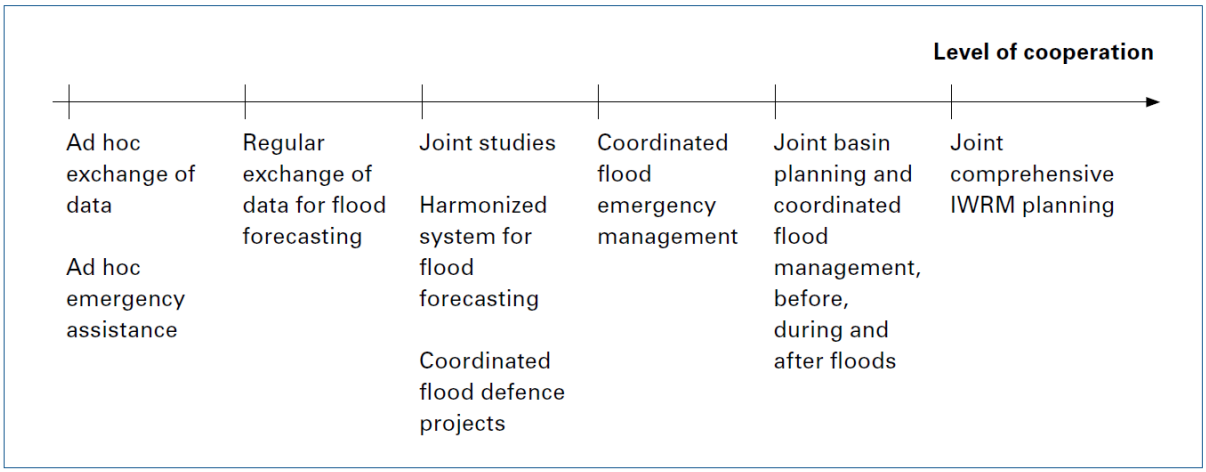

Figure 6 Options for coordination on flood risk management[18]

Such coordination mechanisms and shared activities have the ability to improve the overall effectiveness of flood risk management services, which will help to prevent floods and reduce risks and impacts.

Policy arrangements

The policies and plans regarding flood risk management are usually made at the national level and need to be aligned with the other riparian countries. Additionally, basin-wide policies and plans may be in place that supports cooperation and joint implementation of measures. Development of Flood Risk Management Plans at the transboundary level can be instrumental in this respect. Examples of joint plans include the Danube River Basin Management Plan, the Climate change adaptation strategy for the Rhine catchment, and the draft FRMP for the Elbe.

5.3 Recommendations from the workshop

Find the common interest and find the right process among the parties: Transboundary cooperation is essential to mitigate flood damages across borders. Institutional arrangements are vital for establishing a basis for such cooperation. Finding a common interest – like reducing economic damages from floods – is an important trigger for establishing coordination mechanisms.

[18] UNECE (2009): Transboundary flood risk management. Experiences from the UNECE region.

Transparency of information triggers institutional change: Engaging the public and stakeholder groups is essential for obtaining support for flood management and actions.

Political will is the pre-requisite for effective financing of flood management: Cooperation at the technical level can also be helpful for kick-starting transboundary cooperation, e.g. for flood forecasting, but political cooperation is essential to enable common plans to be developed and measures to be implemented..

Opportunities should be sought for synergies with other sectors. Flooding impacts all types of sectors and the implementation of measures may impact sectors (positively by reducing flooding) or negatively (in the eyes of the sector) by restricting economic activities in certain areas. By including sectors in the planning, the planning process is transparent and less resistance may be met when implementing the flood management plans.

Community based flood management needs to be aligned with the transboundary approach: Flood risk management plans entail many elements (early warning mechanisms, measure implementation) and thus require close cooperation between transboundary neighbours.

6. Overall Conclusions

The workshop on transboundary flood risk management brought together over 50 participants from 26 different countries and 5 international, intergovernmental organisations. The presentations introduced the participants to a wide range of approaches to flood risk management and highlighted the different stages UNECE Water Convention countries currently are in with regards to establishing transboundary cooperation on flooding. While problems are similar across the world, the extent to which they are tackled are different due to financial, and political constraints; solutions for floods are therefore also different.

Despite significant progress having been made since the 2009 workshop on transboundary flood risk management, challenges remain with the following issues identified by the participants:

- Continued lack of coordinating bodies or lack of power of competences to coordinate. Weak national institutions are an obstacle for transboundary cooperation. In basins with multiple countries involved, bilateral agreements may have already been established (or not) but trilateral agreements involving all parties could be improved.
- Language barriers continue to complicate cross-border cooperation.
- Difficulties with cooperation between EU and Non-EU countries in particular due to financial constraints and differences in legislation. On the other hand, EU legislation is also driving continued joint actions and is acting an impetus for change.
- Continued absence of maps including pilot and other districts with required scales and with good quality is the main obstacle for complex flood risk planning. Many countries still have not yet developed joint maps, which is essential for planning joint measures.
- Existing and planned measures at regional level may not (yet) take into consideration transboundary impacts. Measures are still often decided and coordination at the national level.

Countries still in early stages of transboundary cooperation, political agreements/legal frameworks need to be further detailed in technical definitions or guidance documents. Weak national institutions are an obstacle for transboundary cooperation. Transboundary cooperation should not only take place at national levels: utilize transboundary flood management at all levels, from national to local (community based). Another crucial aspect to enable cooperation on transboundary measures is the need for data sharing. While hazard cannot be reduced, they can be forecasted; cooperation is essential to mitigate damages from floods for all countries in a river basin. Data gathering and sharing is a vital step to enabling the development of joint measures. Exposure and vulnerability can be reduced through structural and non-structural measures (e.g. land-use planning, education and awareness).

Participants also highlighted the main factors that contribute to the success of arrangements for cooperation on transboundary flood management and underlying technical systems and institutional arrangements that provide support:

- Cooperation on the political level is important but in lieu of such coordination, cooperation at the technical level might move action along in the mean-time.
- Flood management can be starting point for further water management cooperation.
- Political agreements/legal frameworks need to be further detailed through technical definitions or guidance.

The main 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. More so, flood forecasting and disaster management are highly dependent on early information sharing and require forecasting data from the river basin as a whole.

Overall, the workshop was successful in bringing together stakeholders with different experiences and at different stages in implementing success flood management. As in 2009, the event showed that coming together to share experiences – whether difficulties or successes over time – can stimulate fresh ideas and new approaches to flood management.

To conclude, the main recommendations for improving transboundary flood risk management are:

1. **Data sharing is crucial**: The sharing of data is a crucial point in transboundary flood risk management, and especially important for forecasting and early warning.
2. **Flexibility in methods and data is necessary**: flood regimes change over time, especially if climatic changes are considered. It is therefore necessary to enable the possibility to revise the flood forecasting system.
3. **Climate change will influence the frequency, magnitude and "type" of flooding:** There is an increasing need to include climate change into *(*transboundary) planning approaches to enable adaptation to increasing risks.
4. **Flood risk management cannot stand alone:** Flood risk management plans should be linked to terrestrial and coastal spatial management plans to ensure that future development takes into account flood risks.

5. **One option does not fit all:** It is important to find the best mix of structural and non-structural measures, e.g. structural measures to protect urban areas combined with emergency planning and flood proofing.
6. **Identifying flood risk measures to take is important but political/technical/operational issues still need to be solved**. Political willingness to address the issue is paramount to receiving enough attention to be included in national budgets and capacity to develop technical measures and implementation is needed to ensure the right measures are taken up in the right places within a catchment.
7. **Find the common interest and find the right process among the parties:** Transboundary cooperation is essential to mitigate flood damages across borders. Finding a common interest – like reducing economic damages from floods – is an important trigger for establishing coordination mechanisms.
8. **Opportunities should be sought for synergies with other sectors.** Flooding impacts all types of sectors and the implementation of measures may impact sectors (positively by reducing flooding) or negatively (in the eyes of the sector) by restricting economic activities in certain areas. By including sectors in the planning, the planning process is transparent and less resistance may be met when implementing the flood management plans.

Annex 1 Workshop programme

United Nations Economic Commission for Europe

Ministry of Infrastructure and the Environment

Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety

World Meteorological Organization
Weather • Climate • Water

Second Workshop on Transboundary Flood Risk Management

Geneva, 19-20 March 2015

Conference Room VII of the Palais des Nations, Geneva, Switzerland

THURDAY – 19 March 2015

09:00-10:00 *Registration*

10:00-10:20 Opening Session, Welcome by the Organizers

- Background of the workshop
- Aims of the workshop

10:20-10:40 Setting the Scene: Presentation on Integrated Transboundary Flood Risk Management - Giacomo Teruggi, WMO

10:40-12:30 Session 1: Flood Forecasting; Moderated By Giacomo Teruggi, WMO

- INTRODUCTION TO SESSION (10 min) – Giacomo Teruggi, WMO
  - Background on Flood forecasting
  - Questions
- PRESENTATION BY CHINDWIN BASIN (MYANMAR) (15 minutes, 5 min discussion) - Dr. HtayHtay Than, Hydrological Division, Department of Meteorology and Hydrology, Myanmar

- PANEL DISCUSSION on establishing transboundary flood forecasting and data exchange (55 min)
    - PANJ RIVER (AFGHANISTAN/TAJIKISTAN) - Karimjon Abdualimov, Tajik Hydro Met Service, Tajikistan
    - PRUT RIVER (ROMANIA/UKRAINE/MOLDOVA) - Mikhail Penkov, National Consultant on "Climate Change and Security in the Dniester River Basin", Moldova
    - GANGES BRAHMAPUTRA MEGHNA BASIN (INDIA/CHINA/NEPAL / BANGLADESH / BHUTAN) – Dr. Mohammad Monowar Hossain, Institute of Water Modelling, Bangladesh
    - NILE BASIN (EGYPT/SUDAN) Eng. Tahani Moustafa Sileet, Ministry of Water Resources and Irrigation, Egypt
- QUESTIONS FROM THE PLENARY (25 min)

Lunch 12:30-14:30, with a special session on flood risk management without interpretation

14:30-15:00 Session 2: Measures

- DANUBE (AUSTRIA/ BULGARIA/ BOSNIA AND HERZEGOVINA /CROATIA /CZECH REPUBLIC/ GERMANY / HUNGARY / MOLDOVA/ MONTENEGRO / ROMANIA/ SLOVAKIA/ SLOVENIA/ SERBIA/ UKRAINE) (10 min, 5 min discussion) – Mary-Jean Adler, National Institute of Hydrology and Water Management, Department for Waters, Forests and Fisheries, Romania
- FORON HERAMCE AND MARQUET-SWALLOWED-VENGERON BASINS (SWITZERLAND/FRANCE) (10 min, 5 min discussion), Marianne Gfeller Quitian, Department for renaturation of water courses (Service de renaturation des cours d'eau) – Directorate General for Water - State of Geneva

15:00-18:00 SITE VISIT ON FLOOD MEASURES IN GENEVA CANTON

- Visit of Swiss-French flood protection measures, a coordination programme of joint actions

18:30 Self-paid dinner (venue tbc)

FRIDAY – 20 March

09:30-12:30 Session 3: Flood Risk Management Planning; Moderated by Steven Wade, MET Office, UK

- INTRODUCTION TO SESSION (5 minutes) Steven Wade, MET Office, UK
- RHINE (AUSTRIA/THE BELGIAN REGION OF WALLONIA/FRANCE/GERMANY/ITALY/LIECHTENSTEIN/LUXEMBURG/NETHERLANDS/ SWITZERLAND) (15 min, 5min discussion), Adrian Schmid-Breton, International Commission for the Protection of the Rhine, Germany
- AMUR (RUSSIA/CHINA) (15min, 5 min discussion), Eugene Simonov, Rivers without Boundaries International Coalition, Russia
- TISZA (ROMANIA/ UKRAINE / HUNGARY/ SLOVAKIA) (15min, 5 min discussion), Viktor Durkot, Tisza River Basin Water Resources Directorate, Ukraine
- DNIESTER (UKRAINE/MOLDOVA) (20min, 5 min discussion), Olexandr Bon, Ministry of Ecology and Natural Resources of Ukraine , Gherman Bejenaru, State Hydrometeorological Service, Republic of Moldova

- **11:00-11:15 Coffee Break**

- BREAK OUT GROUPS on developing transboundary flood risk management plans (50 min)
- REPORTING BACK (25 min)

Lunch 12:30-14:30

14:30-16:10 Session 4: Institutional arrangements; Moderated by Jos Timmerman, Wageningen University, Alterra, Netherlands

- INTRODUCTION TO SESSION (10 min), Marloes Bakker, Copernicus Institute of Sustainable Development, Utrecht University, Netherlands
- PRESENTATION ON THE BUG RIVER (UKRAINE, POLAND, BELARUS) (10 min) , Vladimir Korneev, Central Research Institute for Complex Use of Water Resources, Belarus
- PANEL DISCUSSION ON transboundary legal and institutional arrangements, CHALLENGES AND NEEDS (50 min)
    - DRIN-BUNA RIVER BASIN (ALBANIA), Irfan Tarelli, Ministry of Agriculture, Albania TBD
    - BUG RIVER (UKRAINE, POLAND, BELARUS) , Vladimir Korneev, Central Research Institute for Complex Use of Water Resources, Belarus
    - LOGONE RIVER (CHAD-CAMROON) –Younane Nelngar, Ministry of Livestock and Water, Chad

- QUESTIONS FROM THE PLENARY (30 min)

16:10-16:30 Conclusions and Recommendations

Annex 2: Questions at the Workshop

Flood Forecasting

1. What are the main hindrances and opportunities for countries to strengthen the transboundary linkages in flood forecasting and related information exchange?
2. Which role did regional policy frameworks or guidelines of e.g. river basin organizations play in setting up transboundary flood forecasting systems
3. Which ways of warning are the most effective and what kind of low-technology option for warning exists? Which kind of transboundary cooperation is used to share the information about flood warning?
4. How to agree in a cross boarder context on common definitions of key elements of flood forecasting? Countries need to agree on what 1:100 means, as differences lead to very different approaches to management.

Flood risk Management

1. What are the key challenges for future effective flood protection?
2. What institutional arrangements are and multilevel governance is needed to implement a basin-wide approach?
3. Which flood protection measures are of key importance in each basin? Do they differ between basins?
4. What are the main obstacles of the implementation of important flood protection measures?
5. What is needed to set up ideal emergency response mechanisms?
6. Different approaches to post-flood recovery – what needs to be taken into consideration to avoid future damage at the same location?
7. What has been learned from the recent events? How were/are the events evaluated? What is/will be done differently in order to be better prepared for a next event of similar magnitude? Is an enhancement of transboundary cooperation possible/necessary?
8. What can be learned from each other?

Institutional arrangements

1. What institutional arrangements are and multilevel governance is needed to implement a basin-wide approach?
2. What kind of barriers exists in the transboundary context? It is possible to use synergies to other objectives?

3. Does the Water Convention support establishment and improvement of cooperation in your basin?
4. What barriers do you encounter in developing joint flood risk management plans in your basin?
5. Which other sectors (e.g. energy) need to be involved to have an effective management?

Annex 3 Case Study Submissions