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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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The Organisers wish to particularly acknowledge the presenters who provided the useful case study illustrations that served as the basis for the content of the workshop and the participants who attending the workshop and participated in productive discussions on transboundary flood risk management.

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
Hermance and Marquet-Gobé-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).

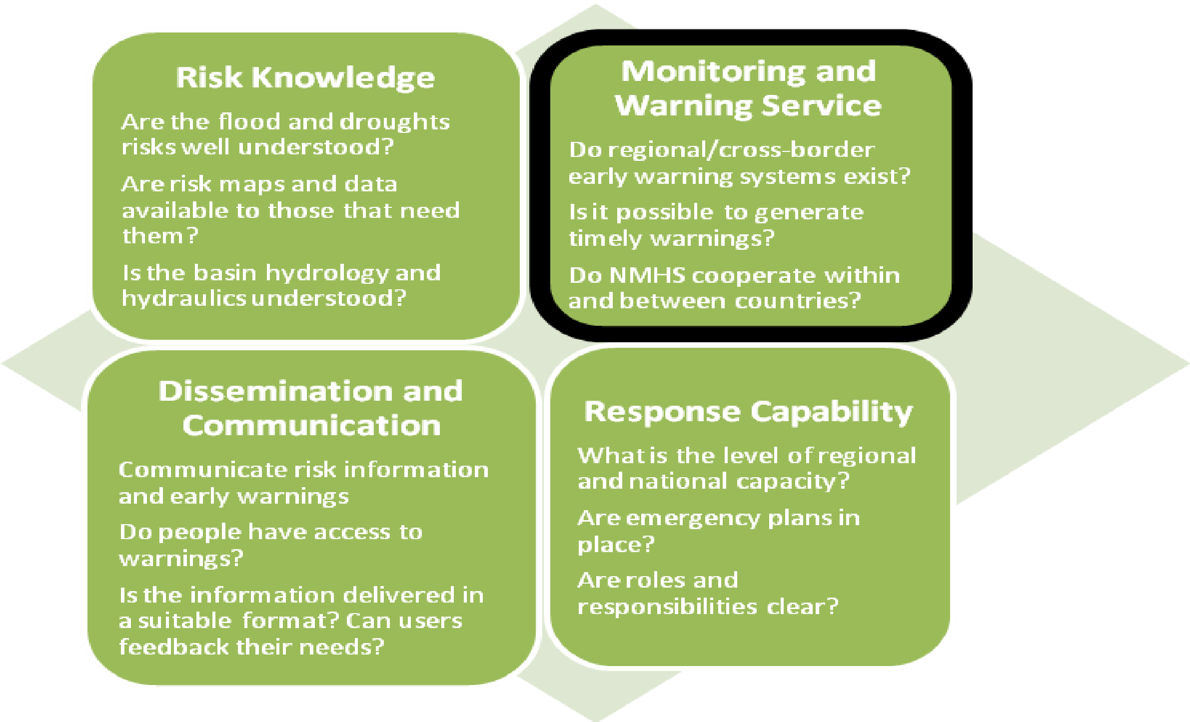


Figure 1 Framework for warning systems[3]

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.

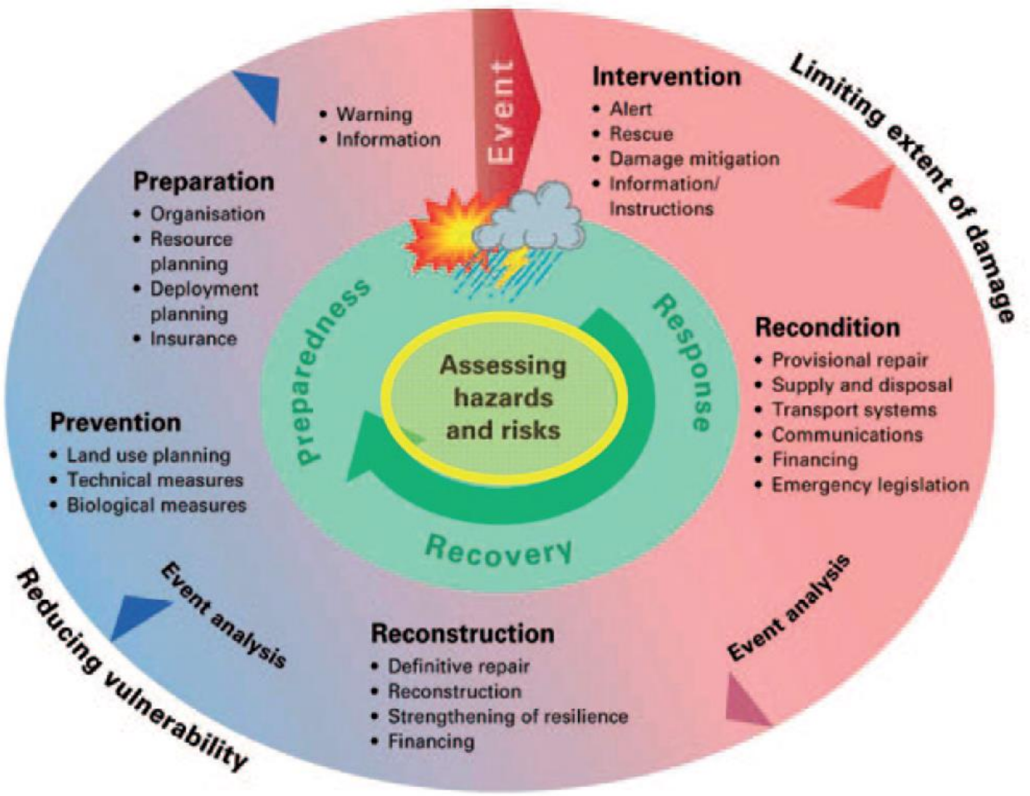


Figure 2 Flood risk management cycle[6]

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].

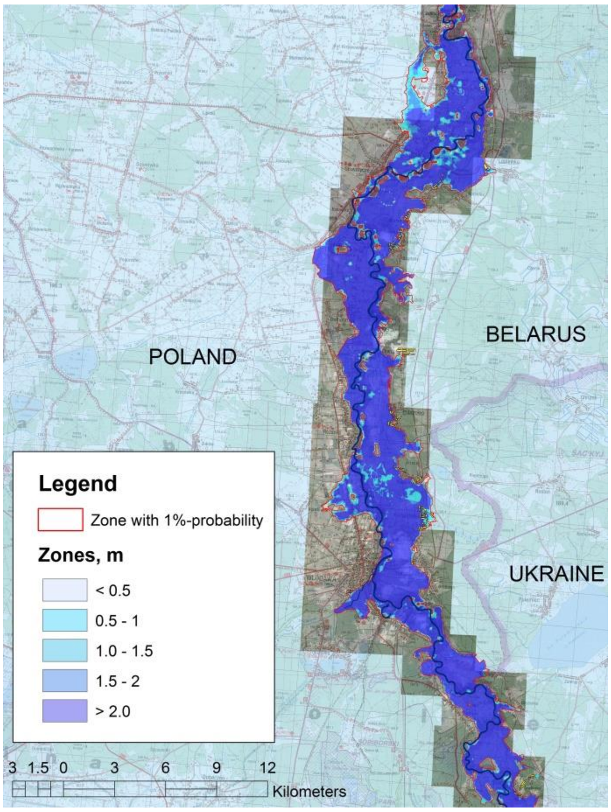


Figure 3 Combined Flood Hazard Maps and Flood Risk Maps for the pilot district of the river Bug[9]

[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 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)).

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

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.

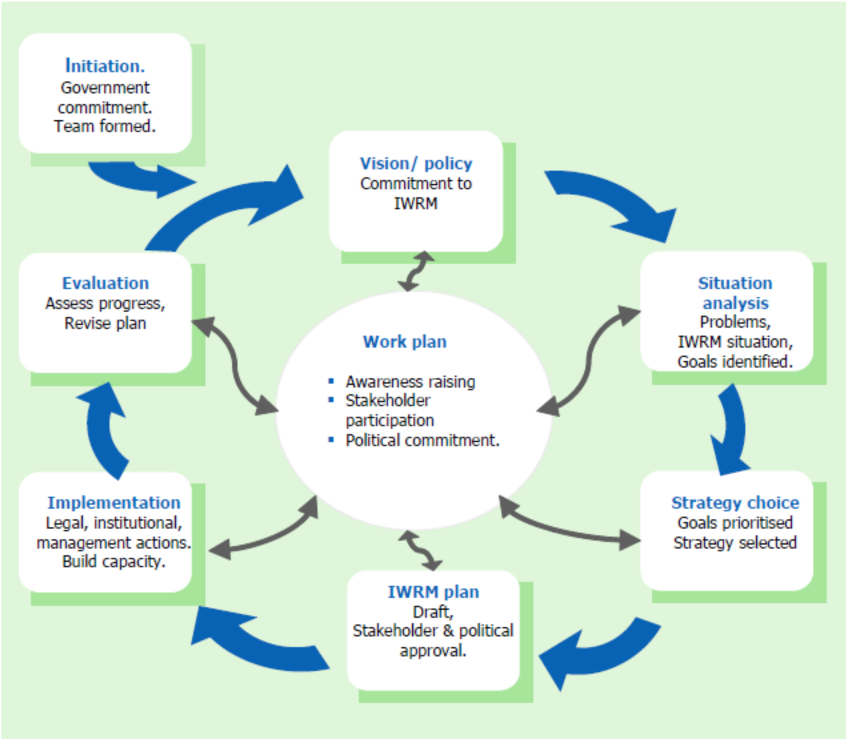


Figure 4 Planning cycle for development a flood risk management plan[13]

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.

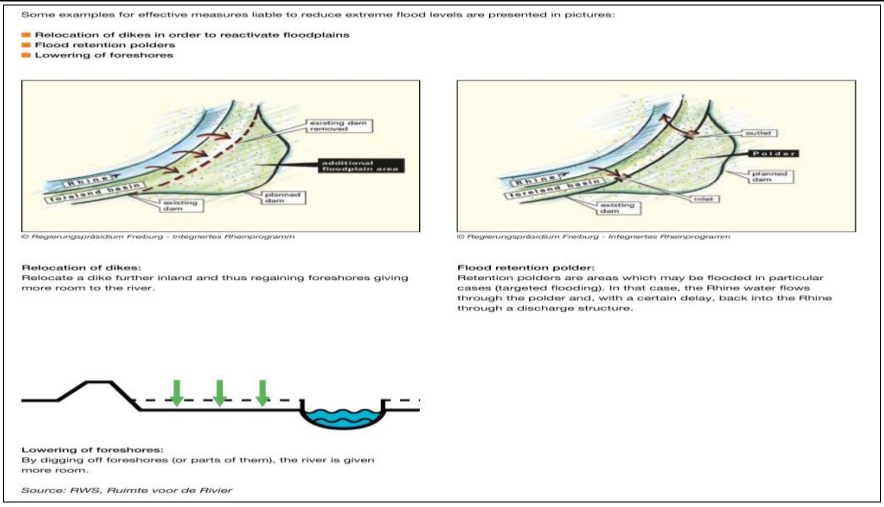
Box 14 Flood risk measures between France and Switzerland

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.



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].

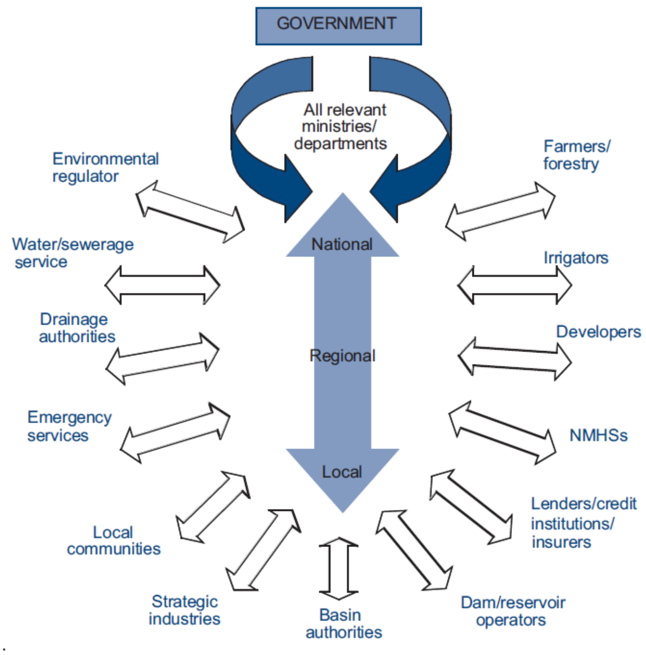


Figure 5 Integration of the various stakeholders and interest groups in flood management[16]

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.

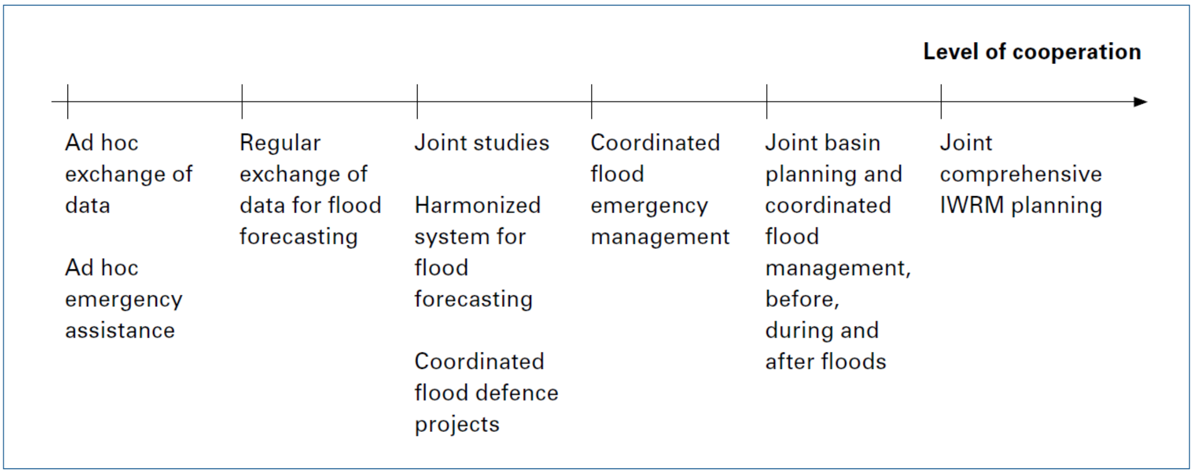


Figure 6 Options for coordination on flood risk management[18]

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

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

TEMPLATE FOR SUBMITTING CASE STUDIES ON TRANSBOUNDARY FLOOD ISSUES

Second workshop on Transboundary Flood Risk Management

Geneva, 19-20 March 2015

1) Name of the river basin(s) you are proposing:

Amur River Basin (Heilong River in Chinese sources)

2) Please shortly describe the river basin/sub-basin, basin States, climatic conditions (e.g. climate zone, precipitation amount, flood season, role of snow and ice melt in flood generation)

The Amur-Heilong is the largest river basin in northeast Asia. The Amur River flows eastwards from the Mongolian Plateau through Mongolia, China, Russia and covers a tiny bit on North Korea at Songhua River headwaters.The Amur-Heilong River is one of the world’s largest free-flowing rivers and, at approximately 4,444 kilometers in length, is the ninth longest river in the world. The Amur river and its tributaries form the border between China and Russia for over 3,000 km, making it one of the world’s longest border rivers.

The basin has monsoon a climate. Nearly two thirds of the basin's precipitation falls in the three months from June to August. May and September are transitional months and the dry season extends for seven months, from October until April during which precipitation is only 15% of the annual total. Floods occur annually during the short three-month wet season, a period during which 84% of the big storms occur. Even so, water is in short supply throughout most of the basin during the much longer dry season.

3) What types of floods affect the river basin (riverine/fluvial floods, flash floods/pluvial floods, coastal floods, groundwater floods, flooding related to reservoir operation, etc.)? Please provide a short account of the major flood events that have affected the basin in the past decade(s) as well as their impacts (e.g., in terms of losses of live, damages to property and overall economic losses). If possible, please indicate how many of the basin States were affected by each event.

Water flow in the Amur-Heilong basin varies widely between seasons and years. At Komsomolsk City on the lower Amur average annual flow is 10,900 m^3/sec. Maximum flow recorder flow in 2013 exceeded 46,000 m^3/sec and minimum recorded flow is just 345 m^3/sec, less than 1% of the maximum. Summer monsoon rains occur across most of the basin and cause the floods that are common in most Amur-Heilong basin rivers. In Russia it is recorded that large floods occur once every 11-20 years in the Upper Amur, once every 7-8 years in the Middle Amur, once every 12-15 years in the Lower Amur.

Water levels in the upper and middle reaches of the basin vary over a range of 10-14 m during the year. In the lower Amur, the water level range is 6-7 m. On average there are 4-6 floods each year, increasing to 6-9 on small rivers. During floods the water surface of the lower and middle Amur-Heilong may expand to widths of 10-25 km. Waters often remain on the floodplain for extended periods.

Floods are one of the most important natural processes and determine, in part, the diversity and productivity of the Amur-Heilong ecosystems. The shaping and dynamics of the vast floodplain wetlands, the major nutrient cycles, and the life-cycles of all aquatic flora and fauna depend primarily on the periodicity, volume, and other characteristics of floods. In 2013, the region experienced severe flooding, that, while devastating to the local population, resulted in an improvement in water quality and river habitat conditions, which was restored to its 1970s state.

In the past in reaction to the losses and suffering among the populace, China's water management has traditionally focused on floods rather than droughts. Flood control relies mainly on construction of reservoirs, detention basins, water diversion and dykes. This is partly strengthened by non-structural approaches such as flood warning and flood forecasting systems. The Songhua Basin flood management strategy was based on new man-made reservoirs and on the raising of dyke elevations to increase the flood protection standard from 1-in-20 to 1-in-30 or 1-in-50 year events.

Extreme flooding events such as those in 1998 and 2013 resulted in huge economic losses. Dykes along the Songhua River and Amur provided little protection. Because people raise crops and occupy homes outside dykes, the consequences are even more severe when catastrophic floods overwhelm the dykes. During catastrophic flood in August-September 2013 much of damage could be attributed to the fact that by August 20 dykes had problems in 8000 places with breaches in 340 kilometers of embankments along the Amur river (13% of total dyke length along Chinese Amur). 1000 settlements with 5 million people were affected by a single 2013 flood in China.

4) Please provide information on arrangements that provide a basis for cooperation in terms of flood management in the basin, such as bi- or multilateral agreements and institutions (e.g. river basin organizations).

There are many bi-lateral agreements between Russia-China-Mongolia related to aquatic resources, but most of them are only marginally related to flood risk management.

The Sino-Russian Agreement on Use and Protection of Transboundary Waters was originally proposed by Russia around 1997 as a general framework agreement to open communication channels between water management agencies of two countries. As water pollution became a high-profile political transboundary issue after 2005, the focus was on water quality, mutual responsibility for water pollution, and compensation for “transboundary impacts”. The resulting Agreement signed in 2008 does not define “transboundary waters” as basins or mention “water use limits/quotas” or other mechanisms or regulating water withdrawal/flow alteration.

Up to date there were 2 working groups being established, one – on water quality and environmental emergencies and another one on the water resources management. Agreement prescribes “joint planning for use and protection of transboundary waters with consideration of previous efforts undertaken”, which means that joint plan on flood-risk management might be considered at some point.

In November 2008 an MOU was signed between Russian Ministry of Emergencies and China Ministry of Environmental Protection on environmental emergencies. In June 2014 an MOU was signed between Russian Ministry of Emergencies and China Ministry of Water Resources on cooperation during flood emergencies.

The Sino-Russian Environmental Sub-commission under the Commission on Regular Meetings of Heads of State regularly addresses various aspects of flood risk management. For example it includes Sino-Russian Working Group on Biodiversity and Transboundary System of Protected Areas that prepared draft and in 2011 two sides signed “Sino-Russian Strategy for Transboundary System of Protected Areas in Amur River Basin" that focuses on wetland protection.” In 2014 Working Group on Biodiversity specifically discussed protection of transboundary floodplain ecosystems with dual purpose of biodiversity conservation and provision of ecological service of flood retention.

5) Please indicate the scope and mandate of these arrangements in terms of flood management (e.g. flood forecasting and warning, emergency assistance, exchange of basin hydrological data and information, joint studies, coordination of flood defence projects, coordinated flood emergency management, joint basin planning (land and water), joint Integrated Water Resources Management plans).

Since 1986 Russia and China exchange hydrological data on daily water levels at 14 gauging stations on each side. In flood emergency they also exchange flood water level forecasts. The “Sino-Russian Strategy for Transboundary System of Protected Areas in Amur River Basin" prescribes joint assessment and preservation measures of ecological functions of transboundary ecosystems, which is directly relevant to flood-retention functions.

The Working Group on Water Resources Management of the Sino-Russian Agreement on Use and Protection of Transboundary Waters was appointed at the 6th meeting of China- Russia Transboundary Water Joint Commission in Jan. 2014 to do the research on 2013 flood, and to submit a joint report. For Report-writing the two sides established a working group of experts. The first meeting of this joint research was held at Harbin, China in April 2014. The two sides reached an agreement on the contents of 《Chinese-Russian Joint Report on the analysis of the extreme flood in Amur River in 2013 (“Joint Report” for short), as well as the list of meteorological and hydrological data supposed to be exchanged and the work plan. Experts of both sides in cooperation with a due division of responsibility made great efforts to collect and sort meteorological and hydrological data, investigate the rainstorm and flood, exchanged the relevant basic data, research on topics of the high water level formation, the role of reservoir regulation, and dyke failure, then formed respective reports blend them in Joint English-language document.

One of important findings during joint research - clarification of immense importance of natural flood-retention capacity of floodplains of Amur river in 2013 flood. Cooperation to preserve and restore this most efficient measure to reduce flood risk - is the most promising direction for transboundary cooperation to reduce negative impacts of future floods.

6) Please provide indication on what are the main factors contributing to success of those arrangements for cooperation on transboundary flood management. What are the major shortcomings in flood management cooperation and the underlying technical systems and institutional arrangements that provide support?

Several factors contributed to the success of cooperation:

- *High-level attention ensures the smooth cooperation*: The 2013 flood affected both sides, the leaders attached great attention. On August 22 and 26, China's Premier, Keqiang Li, communicated through telephone by appointment with Prime Minister of Russia, Dmitri Medvedev. Their communication and attention about the flood defending cooperation has powerfully guaranteed the success.
- *Timely communication played an important role*. During the flood, the two parties strengthened hydrological monitoring, and timely communicated with each other about precipitation, real-time and forecast hydrological information, and reservoir operation information. All these non-engineering measures have played an important role in flood control and disaster mitigation for both sides.
- *Honesty and trust cemented the foundation of cooperation.* During the 2013 flood, the two sides trusted and took care of each other, responded swiftly to any demand or concern raised by the partner. The regulation information of main reservoirs has been closely concerned during the flood; the two sides timely notified the regulation information:

Problems and shortcomings in hydrological monitoring that need improvement:

- From 1960 till 2013 only water level but not discharges have been measured regularly on transboundary watercourses (total length 3500 km). In 2014 the process of regular discharge measurement has been agreed for 7 Russian and 9Chinese gauging stations.
- Daily exchange of hydrological data is conducted only during open water period from June to September
- Daily data exchanges is conducted using outdated technology (e.g. fax)

So far insufficient attention has been paid by both sides to assessment of floodplain capacity to accumulate floodwaters, as well as to risk of increasing flood risks by developing water infrastructure in floodplains. After 2013 both sides documented how construction of bridges, polders, large dykes has led to increasing flood risks. For example China side conducted analysis of dyke failure that vividly shows that large dike construction along Amur River significantly reduces natural flood attenuation capacity of floodplains and may increase water levels in downstream areas during flood.

According to our preliminary estimates floodplains of large watercourses in Amur river basin have flood retention capacity in excess of 150 cubic kilometers, but 10% of this capacity is likely already lost as a result of short-sighted planning and infrastructure development.

7) Please propose one technical area (such as provided under 4 above) or institutional area (e.g. flood management policy, law, organizational setup, finances, capacity building for specific technical areas) that you see as the key area where the flood management system could be improved in the shared basin. Please be as specific as possible.

A common hydrological model of Amur Basin is needed that allows both sides to monitor actual status of transboundary rivers and lakes, functioning of hydropower reservoirs, filling of floodplains, as well as precipitation dynamics in Russia and China.

Such model will:

-Allow for better hydrological forecasts for all parts of the transboundary basin.

-Help to plan measures for flood-risk reduction;

-Assist monitoring of natural flood-retention floodplain and wetland areas;

-Assist planning of repair, reconstruction and construction of water infrastructure;

-Inform development of land-use regulations for floodplain areas;

-Help to use existing live-volume of reservoir more efficiently in flood emergencies.

To ensure persistence and enhancement of natural flood retention capacity of Amur floodplains and other wetlands a joint effort is needed to create transboundary GIS map of major river valleys, including all transboundary watercourses

8) Please provide your name and contact details or name and contact details of appropriate contact person. Please also provide references or websites where more detailed information can be found, if available.

Dr. Andrey Shalygin, member of working group on water resource management under Sino- Russian Transboundary Waters Joint Commission. Member of the expert group drafting Chinese-Russian Joint Report on the analysis of the extreme flood in Amur River in 2013. Chief Researcher at State Hydrological Institute (St. Petersburg, Russia). Telephone +7 921 751 3030, e-mail andrew_shalygin@mail.ru

Dr. Eugene Simonov. member of Sino-Russian Working Group on Biodiversity and Transboundary System of Protected Areas under Environmental Sub-commission of the Commission on Regular Meetings of Heads of State. Member of expert group drafting 《Chinese-Russian Joint Report on the analysis of the extreme flood in Amur River in 2013. Chief Researcher at State Biosphere Reserve Daursky. International Coordinator of Rivers without Boundaries Coalition. Phone +86 13942868942 email. simonov@riverswithoutboundaries.org

Additional data:
https://ru.wikipedia.org/wiki/Наводнения_на_Дальнем_Востоке_России_и_в_Китае_(2013); http://www.eecca-water.net/file/china_and_flood_2013.pdf; http://solex-un.ru/dams/budushee-amura/osvoenie-gidropotenciala/kitayskaya-vodnaya-politika

Ministry of Infrastructure and the Environment

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

World Meteorological Organization
Weather • Climate • Water

United Nations Economic Commission for Europe

TEMPLATE FOR SUBMITTING CASE STUDIES ON TRANSBOUNDARY FLOOD ISSUES

Second workshop on Transboundary Flood Risk Management

Geneva, 19-20 March 2015

1) Name of the river basin(s) you are proposing:

Bug River Basin

2) Please shortly describe the river basin/sub-basin, basin States, climatic conditions (e.g. climate zone, precipitation amount, flood season, role of snow and ice melt in flood generation)

The (western) Bug River is a second-order tributary of the Vistula River (Baltic Sea basin). The Bug forms a part of the country border between Belarus and Poland and between Ukraine and Poland. The Bug springs from the western slope of the Podolian Upland in Ukraine. It flows into Zagzhinskoe water reservoir on the River Narew near Warsaw (Poland). The Bug has a length of 772 km, 587 of which flow across the territory of Poland. Apart from its upper reaches in the territory of Ukraine, where Dobrotvorovskaya and Sokalskaya hydropower plant dams are located, the main riverbed of the Western Bug remains unregulated. However, its tributaries are strongly regulated. Reservoirs are primarily used for irrigation. In Belarus, the Dnieper-Bug Canal connects the Bug with the Pripyat River. About 526,000people live in the river basin. The total catchment area of the Bug river is 39,400 km2: Belarus – 10,400km2 (26.40%), Poland – 19,300km2 (48.98%), Ukraine – 9,700 km2 (24.62%). The Western Bug is a relatively natural river with a great part of its valley functioning as a protected Nature 2000 site.

3) What types of floods affect the river basin (riverine/fluvial floods, flash floods/pluvial floods, coastal floods, groundwater floods, flooding related to reservoir operation, etc.)? Please provide a short account of the major flood events that have affected the basin in the past decade(s) as well as their impacts (e.g., in terms of losses of live, damages to property and overall economic losses). If possible, please indicate how many of the basin States were affected by each event.

Major flood events affected the basin are riverine/fluvial floods caused by spring snow melting and rainy flash which less important than spring flood. Therefore main problem for Bug river pilot district (UA-PL-BY) “Włodawa-Brest” district are winter floods caused by ice jams.

Spring flood in the Western Bug basin normally starts in the first half of March and continues for 40-50 days on average. The maximum spring level exceeds the lowest long-term level by 1.4-2 m on average while during years with high spring floods this value reaches 2-3.8 m. Summer-autumn low water periods are often interrupted by rain freshets. Spring freshets have a distinct wave pattern, which normally continues for 15 - 20 days.

During the spring flood of 1999 the discharge exceeded average long-term values by 48%. Floods are more typical of middle and upper parts of the basin (Ukraine) and for the part of the river along the border between Belarus and Ukraine. Changes in the hydrological regime during the period of floods affect the quality of water in the river due to snow thaws and erosion of adjacent territories.

Potential significant flood risk for the Bug River Pilot District in the frame of FLOOD-WISE Project (2011-2012) “Domachevo (Belarus) – Wlodawa (Poland) – Grabovo (Ukraine)” exists for the some part of territory of the next settlement:

- Orchowek, Wlodawa, Dolgobrody, Suszno, Parosla, Sobibor (Poland);
- Domachevo, Borisy, Priborovo, Komarovka, Tomashovka (Belarus);
- Wilshanka, Grabovo (Ukraine).

Estimated number of inhabitants affected by flood on the pilot district “Domachevo (Belarus) – Wlodawa (Poland) – Grabovo (Ukraine)” is not more than 2000 persons including affected inhabitants on urban rural areas: Wlodawa (about 110 persons); Wilshanka (about 50 persons); Grabovo (about 50 persons). Other estimated number is forming mostly at the cost of Belarusian territory because there are no dikes from the Belarusian side on the Bug River Pilot District.

Bank erosion of the Bug River is very significant problems for all countries of the Bug river basin (Ukraine, Poland and Belarus) because Bug is a river with a strong meanders. This problem has more effect in case of floods.

4) Please provide information on arrangements that provide a basis for cooperation in terms of flood management in the basin, such as bi- or multilateral agreements and institutions (e.g. river basin organizations).

There are no cross-border committees or working group on regular base between Poland and Belarus.

Some Poland-Belarusian working group are functioning on irregular base between local authorities (administration), environmental protection structures, emergency boards and main stakeholders in frames of realization of the some specific agreements (i.e. “Agreement on cooperation and exchange of hydrometeorological information between the Department of Hydrometeorology of the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus and the Institute of Hydrometeorology and Water Resources of

Poland") and some projects of transboundary cooperation (i.e. INETRREG Project FLOOD-WISE).

Cooperation in the field of water resources management of the Western Bug Transboundary River Basin between Poland and Ukraine is carrying out in frames of Agreement between Governments of Poland and Ukraine in the field of water industry on transboundary waters from 10.10.1996. Annual meetings of common fifth working groups and one commission are taking place on transboundary waters.

There is special Agreement between Western Bug Basin Water Department (Lutsk, Ukraine) and Regional Water Board (Warsaw, Poland) also which is prolonging every 3 years.

The scope of arrangements between Belarus and Poland as well as between Poland and Ukraine mostly related to emergency assistance and exchange of hydrological data and information on irregular base (mainly – in case of emergency situations.

The countries of the Bug River Basin (Poland, Belarus and Ukraine) each have their own programme of flood protection measures which mostly aim at dike construction to protect some settlements from floods.

5) Please indicate the scope and mandate of these arrangements in terms of flood management (e.g. flood forecasting and warning, emergency assistance, exchange of basin hydrological data and information, joint studies, coordination of flood defence projects, coordinated flood emergency management, joint basin planning (land and water), joint Integrated Water Resources Management plans).

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 common approach (Poland, Belarus and Ukraine) was used for the floods modeling and mapping based on the next suggestions:

- All Bug countries (Poland, Belarus, Ukraine) are using 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 modeling based on 1D Seant –Venan generalized equations;
- To use hydrological data from Poland, Belarus and Ukrainian sides;
- To use morphological data including existing cross sections coordinates (from Belarus side) and general description of the cross section of the Bug river for the Polish territory;
- To use GIS modeling 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.

For the development of the FRMs and FHMs the Digital Elevation Model (DEM) for the pilot transboundary district (Poland – Ukraine – Belarus) was developed with using of the next information:

- STRM-model (Shuttle Radar Topography Mission conducted in 2000 to obtain elevation data for most of the world. It is the current dataset of choice for digital elevation model data (DEM) since it has a fairly high resolution - about 90 meters for the Bug River Basin, has near-global coverage, and is released into the public domain);
- Detailed maps of Wlodawa scales of 1:10 000 and 1:25 000;
- Map of the entire Bug River Basin of 1:50 000 (map from the Soviet time);
- Map of the entire Bug River Basin of 1: 100 000 (Poland map);
- Google maps.

Flood Hazard Maps and Flood Risk Maps were developed based on calculated water levels with using DEM and data about land use (picture 4). FHMs for Wlodawa town were developed additionally for 1%, 5% and 10% probabilities.

The countries of the Bug River Basin (Poland, Belarus and Ukraine) have their own programs on flood protection measures which mostly devotes to engineering dikes construction to protect some settlements from floods. The Flood Risk Prevention Measures for river Bug (Pilot Project area) mainly consists of the precautions that have to be taken before a flood disaster (Prevention, Protection and Preparedness). There are similar approaches in Belarus and in Ukraine for the engineering construction against flood: levels of dikes should be not less than maximum levels of 1%-flood probability take into account all historical data about floods plus 1 meter. In general most of objectives and measures on flood prevention, protection and mitigation in Bug river are the same or similar in all Bug countries.

6) Please provide indication on what are the main factors contributing to success of those arrangements for cooperation on transboundary flood management. What are the major shortcomings in flood management cooperation and the underlying technical systems and institutional arrangements that provide support?

The main factors contributing to success of those arrangements for cooperation on transboundary flood management and underlying technical systems and institutional arrangements that provide support:

- Improvement efficiently of early warning system;
- Diminish flood risks;
- Inform people about flood risks and measurement plans;
- Assess effects of measures cross border;
- Improvement of the cross border information exchange and using common information platform (morphology, hydrology and hydraulics) for flood forecast;
- Decreasing of negative effects downstream;
- Find the best solution based on the entire river basin management approach for both sides of the river Bug (for both sides of the border).

Threats and challenges related to flood risk planning:

- Cross border coordination, coordinate all managing authorities and stakeholders is problematic because of no cross border coordination trilateral committee or group yet;

- The language barrier complicates cross-border cooperation: three languages and two alphabets: there are not problems for border cooperation between Ukraine and Belarus because there is no need for visa and Russian language can be used as common language;
- The Bug River is also boundary river with EU – Non EU countries, therefore there are some problems in cooperation and data exchange of Non EU-countries (Ukraine, Belarus) with Poland and other EU-countries;
- Absence of maps of the entire Bug River Basin including pilot and other districts with required scales and with good quality is the main obstacle for complex flood risk planning;
- Bank strip of the river Bug in Belarus and in Ukraine is closed territory because it is military zone of border (it can be considered as some obstacle and some benefit for flood risk planning at the same time);
- Existing and planned measures in Bug countries do not (yet) take into consideration transboundary impact of own measures and activities essentially bank protection which is carried out unilaterally.

7) Please propose one technical area (such as provided under 4 above) or institutional area (e.g. flood management policy, law, organizational setup, finances, capacity building for specific technical areas) that you see as the key area where the flood management system could be improved in the shared basin. Please be as specific as possible.

Strengthening of cross border contacts and the forming of an trilateral Bug River Basin Committee would be a good suggestion for increasing efficiency of Flood Risk Management in the Bug River Basin, including improvement of exchange of data, coordination of border measures.

In general most of objectives and measures on flood prevention, protection and mitigation in Bug river are the same or similar in all Bug countries.

For the pilot district of river Bug the prototype of cross-border hazard and risk maps were generated within FLOOD-WISE project in 2011-2012 with small scale which shows good practice, experience and used approach based on common hydrological and hydrodynamic models. International projects on the Flood Risk Maps and Flood Risk Management Plan for the entire transboundary river Bug district can be proposed and realized based on more detail cartographic (large scale) information and common hydrological and hydraulic model.

8) Please provide your name and contact details or name and contact details of appropriate contact person. Please also provide references or websites where more detailed information can be found, if available.

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TEMPLATE FOR SUBMITTING CASE STUDIES ON TRANSBOUNDARY FLOOD ISSUES

Second workshop on Transboundary Flood Risk Management

Geneva, 19-20 March 2015

1) Name of the river basin(s) you are proposing:

Chindwin River Basin

2) Please shortly describe the river basin/sub-basin, basin States, climatic conditions (e.g.climate zone, precipitation amount, flood season, role of snow and ice melt in flood generation)

The Chindwin river basin is located in the North Western part of Myanmar. The Chindwin river is the third largest river in Myanmar. It is located in Sagaing Region, where meteorological andhydrological data are available at the stations along this river, such as Hkamti, Homalin, Mawlaik, Kalewa and Monywa, which are situated between 21° 30′ and 27° 15′ N Latitude and between 93° 30′ and 97° 10′ E Longitude. The length of Chindwin River is 901 km and the catchment area is about 110,350 km^2. Since it passes through the mountainous region, numerous streams, flow into the Chindwin River. The important tributaries of Chindwin River are U Yu and Myitha, where U Yu flows into Chindwin near Homalin and Myittha near Kalewa, respectively.

3) What types of floods affect the river basin (riverine/fluvialfloods, flashfloods/pluvial floods, coastal floods, groundwater floods,flooding related to reservoir operation, etc.)? Please provide a shortaccount of the major flood events that have affected the basin in the pastdecade(s)as well as their impacts (e.g., in terms of losses of live, damages toproperty and overall economic losses).If possible, please indicate howmany of the basin States were affected by each event.

Floods are one of the natural disasters that occur in Myanmar every year. Floods generally occur during the southwest monsoon (June to October), when the westerly depression system and the low latitude tropical cyclone system may cause macroscopic rainstorms. These floods have caused significant damage to livestock, agricultural crops, roads, bridges and buildings etc. It is evident that the problem of river flooding is getting more and more acute due to human intervention in the flood plain at an ever increasing scale. It has been gradually realized that it is more rational to try minimizing the risk and damage involved the floods rather than formulating structural measures for containing the river.

Severe flood years in Chindwin Basin include 1973, 1974, 1976, 1977, 1979, 1988, 1989, 1991, 1997, 2002, 2004, 2007 and 2008. This has led to loss of lives and properties, damage to critical infrastructure, economic loss and health related problems such as outbreak of water borne diseases when the lakes, ponds and reservoirs got contaminated.

4) Please provide information on arrangements that provide a basis for cooperation in terms of flood management in the basin, such as bi- or multilateral agreements andinstitutions (e.g. river basin organizations).

Regarding flood management, the Department of Meteorology and Hydrology cooperate together with Relief and Resettlement Department, the General Administrative Department, Irrigation Department, the Directorate of Water Resources and Improvement of River Systems, the Department of Agriculture Planning, Department of Health, the Myanmar Red Cross Society and the Fire Services Department for disaster management activities. The flood disaster management committees are organized with above mentioned departments and organizations in every cities in flood prone areas. They work together in order to reduce the loss of lives and properties.

5) Please indicate the scope and mandate of these arrangements in terms of floodmanagement (e.g. flood forecasting and warning, emergency assistance,exchange of basin hydrological data and information, joint studies,coordination of flood defence projects, coordinated flood emergencymanagement, joint basin planning (land and water), joint Integrated Water Resources Management plans).

The main responsibilities of the Hydrological Division under Department of Meteorology and Hydrology (DMH) is to issue flood warnings and bulletins, the daily water level forecast, 10 days advanced water level forecast, monthly water level forecast, seasonal water level forecast and significant water level bulletins. DMH takes the responsibility in flood disaster management activities by cooperating with other related departments and organizations. The Relief and Resettlement Department and General Administration Department and the Myanmar Red Cross Society distribute emergency assistance during and after disasters. All related departments in flood disaster management activities cooperate together with exchange of hydrological data and flood information, and also implement the flood related projects and Integrated Water Resources Management plans.

6) Please provide indication on what are the main factors contributing to success of those arrangements for cooperation on transboundary flood management. What are the major shortcomings in flood management cooperation and the underlying technical systems and institutional arrangements that provide support?

On the national level, clear responsibilities, and the good coordination of flood forecasting and warning clearly is a main factor for effective flood management. Under the guidance of the Director General of the Department of Meteorology and Hydrology (DMH), a division headed by the Director of Hydrology has been formed to take the responsibility for issuing flood warnings.The River

Forecasting Section set up under DMH is presently responsible for issuing daily water level forecasts, flood wrnings and bulletins.

During the monsoon season, as soon as a heavy rainfall warning is issued, careful watch on the possibility of flooding have been made. If the water level of any station along these rivers is going to reach or exceed its town danger levels, the flood committee will be informed immediately.The flood management committee comprises of local authorities, warning providers, relevant departments and local NGOs collaborate for flood disaster management. The decision for evacuation is made by local authorities and flood disaster management committees. Each member/team of the community is given specific instructions and responsibilities in case of evacuation. In order to facilitate evacuation planning, the vulnerable areas are clearly identified by using past experience in flood inundated area.

Due to the good organization, the lead time for issuing flood warning 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. The flood forecasting and warning system of the department cover eight major river basins.

Shortcomings clearly include the techniques employed, as the multiple regression technique used does not take into account rainfall forecasts and dynamic changes along the rivers. DMH is trying to undertake various modernization schemes to make the forecasting work more efficient, reliable and to increase the warning time and also to extend the flood forecasting system in Myanmar. Also, no comprehensive monitoring and modeling exists for the whole country.

7) Please propose one technical area (such as provided under 4 above) or institutional area (e.g. flood management policy, law, organizational setup, finances, capacity building for specific technical areas) that you see as the key area where the flood management system could be improved in the shared basin. Please be as specific as possible.

The major shortcomings, or gaps, for more effective flood risk management in Myanmar are the following:

- Lack of instruments for real time data observation, such as rainfall, water level, etc.
- Lack of real time data for utilization of flood forecasting.
- No mobile Doppler Radar.
- Lack of communication system.
- No information from dams, reservoirs and weirs.
- Lack of co-ordination among government departments/organizations.
- Insufficient flood related data and network (non-automatic).
- Insufficient knowledge about flood hydrology (rainfall runoff estimation, flood volume estimation, flood routing etc.) in flood related departments.
- Lack of early warning system for dangerous hydro-meteorological phenomena and lack of flood risk maps.

8) Please provide your name and contact details or name and contact details of appropriate contact person. Please also provide references or websites where more detailed information can be found, if available.

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TEMPLATE FOR SUBMITTING CASE STUDIES ON TRANSBOUNDARY FLOOD ISSUES

Second workshop on Transboundary Flood Risk Management

Geneva, 19-20 March 2015

1) Name of the river basin(s) you are proposing

Danube Basin

2) Please shortly describe the river basin/sub-basin, basin States, climatic conditions (e.g. climate zone, precipitation amount, flood season, role of snow and ice melt in flood generation)

19 countries share the Danube River Basin, which makes it the world’s most international river basin – figure 1. All countries sharing over 2,000 km² of the Danube River Basin and the European Union are contracting parties of the ICPDR. The Danube countries came together to sign the Danube River Protection Convention (DRPC) in 1994 and established the International Commission for the Protection of the Danube River (ICPDR) in 1998 to fulfil the Convention’s objectives. The ICPDR is made up of 15 contracting parties (Austria, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Germany, Hungary, Moldova, Montenegro, Romania, Serbia, Slovakia, Slovenia, Ukraine and the European Union) committed to implementing the DRPC; it is a forum for coordination and cooperation on important water management issues.

Flooding is the most common natural disaster in Europe and, in terms of economic damage, the most costly one. There have been 78 significant floods along the Danube over the last nine centuries; 23 of them took place in the 18th century before extensive flood protection works were started.

Man-made changes to the natural course of the Danube waterways have interrupted river and habitat continuity and have disconnected wetlands and changed water quantity and flow conditions. Draining wetlands for agriculture often provides only marginal farmland while destroying unique wetland habitat while introducing foreign varieties of trees to floodplain forests and clear cutting in the name of industry eliminates undergrowth and alters the function of the floodplain ecosystem. Building towns and villages in floodplain areas also leaves them prone to damage from flooding.

3) What types of floods affect the river basin (riverine/fluvial floods, flash floods/pluvial floods, coastal floods, groundwater floods, flooding related to reservoir operation, etc.)? Please provide a short account of the major flood events that have affected the basin in the past decade(s) as well as their impacts (e.g., in terms of losses of live, damages to property and overall economic losses). If possible, please indicate how many of the basin States were affected by each event.

Most attention is given to floods in lowland plains; however, flash floods and torrential floods of small streams have even higher damage potential. The valleys of the Central Alps, the peripheral mountains, the Carpathians and Dinarians, belong to regions with such type of risks, combined with debris and mud flows. Due to climatic and morphologic conditions ice jam floods may also occur along the Danube and its tributaries in the Carpathian basin.

Since then significant areas of natural floodplains have been lost through drainage for agriculture, city development and flood protection dykes – 80% in total, along the Danube Floodplain. Recent years saw a steepening in the curve of flood frequency, and high-water marks have set records three times since 2002. Five of the most significant floods have occurred in the last 10 years. Neglected levies contributed to this damage, along with long winters and unusually heavy snow and rain. Multi-annual averages for precipitation have been exceeded by 1.5 to 2.0 times recently, a maximum never before observed since systematic instrumental weather observations have been available.

The increasing regularity of dangerous hydro-meteorological phenomena is a cause for concern. Estimation scenarios by the European Environmental Agency predict that flood damage and the number of people affected by flooding will rise substantially by 2100 as a result of climate change, with one scenario estimating a rise in flood damage of some 40% and an increase in the number of people affected of around 242,000 (about 11%). The EU formalized flood management in 2007 through the Flood Directive. The ICPDR coordinates its implementation in the Danube Basin.

4) Please provide information on arrangements that provide a basis for cooperation in terms of flood management in the basin, such as bi- or multilateral agreements and institutions (e.g. river basin organizations).

Since 2000, the ICPDR supports the cooperation between the Danube River Basin countries towards the implementation of the EU Water Framework Directive. In 2007, this was extended to the EU Floods Directive. In response to the danger of flooding, the ICPDR adopted the Action Programme on Sustainable Flood Protection in 2004. The goal of this program is to achieve a long-term and sustainable approach for managing the risks of flooding to protect human life and property, while encouraging conservation and improvement of water-related ecosystems.

The ICPDR comprises primarily of national delegations that meet twice a year. With a secretariat based in Vienna, it is chaired by a president who serves for one year, and the presidency is passed on from one member country to another in alphabetical order. Much of the work of the ICPDR is done by Expert Groups, panels of specialists from the ICPDR member countries and 21 official observers.

5) Please indicate the scope and mandate of these arrangements in terms of flood management (e.g. flood forecasting and warning, emergency assistance, exchange of basin hydrological data and information, joint studies, coordination of flood defence projects, coordinated flood emergency management, joint basin planning (land and water), joint Integrated Water Resources Management plans).

In response to the danger of flooding, the ICPDR is engaged in a range of activities that aim to manage flood risks in a sustainable way. This is done in line with the ICPDR Joint Action Programme and the EU Floods Directive. The Action Programme is based on UN-ECE Guidelines on Sustainable Flood Prevention, EU Best Practices on Flood Prevention, Protection and Mitigation and on EU Communication on flood risk management, COM(2004)472.

Targets of the Action Programme are set on a basin-wide and a sub-basin level taking into account the above-mentioned principles. There are four major basin-wide targets, which are currently under implementation:

(i) Improvement of flood forecasting and early flood warning system. Interlinking of the national and/or regional systems aims to improve the overall coordination and transboundary coherence of flood monitoring and forecasting systems. A Danube Flood Alert System based on the LISFLOOD model has been developed by the EC JRC in Ispra.

(ii) Support for the preparation of and coordination between sub-basin-wide flood action plans. The ICPDR is a coordination platform for preparation of flood action plans for the river sub-basins. Linking of flood risk management with the river basin management is one of the key goals of the ICPDR.

(iii) Creating forums for exchange of expert knowledge. Measures are being taken towards sharing of experience and coordinated development and promotion of best practices on flood risk management. A web-based info exchange platform has been developed on the internal area of the ICPDR website, providing thematic collection of information related to the targets of the ICPDR Action Programme on Sustainable Flood Protection in the Danube River Basin as well as the useful links to other relevant websites.

(iv) Recommendation for a common approach in assessment of flood-prone areas and evaluation of flood risk. Development of flood risk maps is one of key prerequisites to an efficient flood risk management and it is a key part of the EU Floods Directive. 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 prioritising, justifying and targeting investments in order to manage and reduce the risk to people, property and the environment.

Based on the provisions of the EU Floods Directive and using the EXCIMAP Guide of Good Practices for flood mapping in Europe the ICPDR developed and adopted the minimum recommendations for flood risk mapping in the Danube River Basin in 2007.

At present, within the EU Transboundary Cooperation, the Danube Flood Risk Mapping Project, "Floodrisk" has been launched with the aim to develop uniform flood risk maps for the Danube River defining flood hazards and vulnerability. The outcomes of the project will form the basis for targeting measures and reducing flood damage in the Danube Basin.

6) Please provide indication on what are the main factors contributing to success of those arrangements for cooperation on transboundary flood management. What are the major shortcomings in flood management cooperation and the underlying technical systems and institutional arrangements that provide support?

The natural course of the rivers in the Danube River Basin was altered for centuries, mainly for agriculture, hydropower generation, flood defense, and navigation. Hydromorphological alterations such as river interruptions, the disconnection of wetlands, or water abstraction can provoke changes in the natural structure of rivers. As a response, the ICPDR has started initiatives that include the restoration of river continuity, the establishment of green corridors, and the construction of fish migration aids. In addition, the ICPDR engages in an active dialogue with representatives from the hydropower, flood protection and navigation sector to work towards the restoration of a natural river morphology.

7) Please propose one technical area (such as provided under 4 above) or institutional area (e.g. flood management policy, law, organizational setup, finances, capacity building for specific technical areas) that you see as the key area where the flood management system could be improved in the shared basin. Please be as specific as possible.

The overall objective of the DanubeFloodrisk project was to develop and produce high quali-ty, stakeholder oriented flood risk maps for the transnational Danube river floodplains to provide adequate risk information for spatial planning and economic requests. Risk information is the basis for sustainable development along the Danube River. The key objective was reached by intensive transnational cooperation and stakeholder integration. The goal was to link scientific progress in harmonization of approaches and data with practically oriented stakeholder and end user involvement. Vertical and horizontal cooperation are the two pillars of the project.

The project’s single objectives are:

- Development of a joint mapping method for flood risk and harmonization of data sources.
- Production and provision of risk maps and risk information (hazard and risk at-las in the scale of 1:100000, also published via DVD and internet).
- Integration of relevant stakeholders and users on different levels into the defi-nition and realization processes.
- Involvement of different economic aspects of land use in the river basin like spatial planning, recreation and agriculture as well as energy supply or health service.
- Linkage of flood risk mapping and provision of maps as basis for planning, e.g. within the EU Floods Directive.
- Development and distribution of exemplary procedures within the Danube countries and beyond.
- Reflection of the EU Directives, e.g. WFD, Floods Directive, providing feed-back based on the experiences of the project cooperation by using the plat-form of the ICPDR Flood Protection Expert Group.

8) Please provide your name and contact details or name and contact details of appropriate contact person. Please also provide references or websites where more detailed information can be found, if available.

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http://www.icpdr.org/main/activities-projects/flood-risk-management

www.danube-floodrisk.eu

www.floodcba.eu

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TEMPLATE FOR SUBMITTING CASE STUDIES ON TRANSBOUNDARY FLOOD ISSUES

Second workshop on Transboundary Flood Risk Management

Geneva, 19-20 March 2015

1) Name of the river basin(s) you are proposing:

Dniester River basin

2) Please shortly describe the river basin/sub-basin, basin States, climatic conditions (e.g. climate zone, precipitation amount, flood season, role of snow and ice melt in flood generation)

The Dniester River Basin is a transboundary river and spreads on the territory of three countries Poland, Ukraine and Republic of Moldova. Over 70% of the basin is situated in limits of Ukraine and only 27% belong to Republic of Moldova. The total area of the basin is approximately 72100 km2 and the length is 1352 km. The basin is conventionally divided in three parts: the Upper Part represents the region from the Dniester spring to confluence with Zolota Lypa River (upstream Zalishchyky Village), the Middle Part is assigned to the region from Zolota Lypa River to Dubasari Town (generally characterized by a highland landscape) and Lower Part characterized by plain landscape. The Upper part lays in Carpathians and represents only 30% of the basin area but due to high amount of precipitations, 70 % of the Dniester runoff is generated in this area. Average amount of precipitations over basin area decreases constantly from 1300-1000 mm in the Upper part to 400-500 in the Lower Part.

The Dniester River represents the main fresh water source of the Republic of Moldova. In the limits of Moldova, the Dniester average discharge is 312 m3/s, increasing up to 450-500 m3/s in April and decreasing below 200m3/s during winter months. Total Dniester average volume is approximately 9.8 km3. In years with humidity deficit Dniester water resources are estimated at 6 km3, in years with high humidity the volume increases over 12 km3, being 2 times higher than in dry periods. Being a transboundary river the Dniester water resources are equally divided by Ukraine and Republic of Moldova. These water resources are considered as country propriety.

3) What types of floods affect the river basin (riverine/fluvial floods, flash floods/pluvial floods, coastal floods, groundwater floods, flooding related to reservoir operation, etc.)? Please provide a short account of the major flood events that have affected the basin in the past decade(s) as well as their impacts (e.g., in terms of losses of live, damages to property and overall economic losses). If possible, please indicate how many of the basin States were affected by each event.

The main reasons for the formation of flooding on rivers Dniester, repeated 3 to 8 times a year, is the natural and climatic features of the Carpathian region. Formation of flooding here is due to increasing water levels in rivers, which causes flooding areas of settlements and industrial facilities, resulting in considerable economic losses.

Instrumental observations as well as historical and archival records which contain valuable information about the spontaneous nature of this phenomenon provide a general idea of the size and frequency of the Dniester floods. The Dniester floods chronology covers a period of seven centuries (1146 to 1840 years). First mention of the most powerful floods of the Dniester River is given in Hypatian chronicle in 1146. The Dniester floods, which took place in 1230, 1572, 1649, 1668, 1700, 1730, 1757, 1814, 1823, 1864 are described in details in archival documents. Instrumental observations of flood wave on the Dniester River began in 1881 (Bender gauging station). The long range of observation dataset allows performing a detailed description and assessment of flood risk of the Dniester River during the time. The most powerful floods of the last century were reported in 1911, 1941, 1955, 1969, 1980, 1989, 2008 and 2010. The total damage from flooding in Moldova for the period from 1947 to 2000 amounts to 285.4 million lei.

The main climatic factor which generates the Dniester catastrophic flood events is extreme meteorological conditions in Carpathian region, manifested especially in summer period. In this region rainfall intensity exceeds 250 mm/day and its spatial distribution spreads on a scale from 100 km2 up to 3000 km2. The effect of heavy rains is amplified by Carpathian steep slopes and as a consequence fast slope runoff, high debris flow and water levels are formed. The most dramatic flood of the last 30 years occurred in July-August 2008. This flood was generated by stationary cyclonic activity over Western part of Ukraine, in Carpathians. From 22 to 27 July in the upper basin of the Dniester observed pulling a heavy rain, precipitation was 48-177 mm, 195-344 mm in some places (51-275% of monthly norm), which led to the formation of heavy floods. At three gauging stations, located in the center of this cyclone, the total sum of rain exceeded 300 mm.

Flooding on the Dniester in a few posts exceeded the historical maximum of water level rise. The total rise of water level was 4.2 m, sometimes up to 6.2 m in Ukraine and up to 9 m on some sectors in Moldova in such a way overflooding protection levees and as a result agricultural land, settlements and infrastructure. This resulted in the flooding of the territories and settlements along the river in both countries: Ukraine and Moldova.

The 2008 flood was to a large extent an unexpected event, not adequately forecasted by the Ukraine's system of meteorological monitoring and forecasting for extreme weather events and, therefore, caught the population by surprise, with no time to secure their material assets. From 24 to 25 July, the reservoir experienced a sharp increase of the water flow by 620 m3/s (from 480 m3/s to 1100 m3/s). According to Lviv and Chernivtsi HydroMet posts, inflow at Zalishchyky post was expected to be within the 5500-6600 m3/s, creating a difficult situation for a correct propagation of outflow (historical significance of water flow and lack of free volume in the reservoir at the beginning of flood). To avoid forcing a dangerous level of the reservoir and possible destruction of hydroelectric dams it was decided to increase the outflow to very large discharges (up to 3900 m3/s) which created significant flooding areas located downstream of the reservoir. Republic of Moldova was informed regarding reservoir regime changes.

This intense flood caused damages over US$ 130 mil. to the Republic of Moldova: 65% of the total damage was damage done to property, 20% to infrastructure, particularly to roads, 15% was the damage caused to agricultural land (over 4800 hectares were flooded from which 1,514 hectares belonging to individuals). Total damages caused to Ukraine were 3 times higher being estimated to 6 billion Ukrainian Hryvna.

4) Please provide information on arrangements that provide a basis for cooperation in terms of flood management in the basin, such as bi- or multilateral agreements and institutions (e.g. river basin organizations).

Main arrangements between Moldova and Ukraine that provide cooperation in terms of flood management applicable in the Dniester River Basin are:

- Intergovernmental agreement on border waters signed in 1994,
- Intergovernmental agreement to prevent industrial accidents and natural disasters signed 1998,
- Protocol on anti-flood measures to the 1994 intergovernmental agreement on border waters signed in 2006,
- Treaty on cooperation in the field of protection and sustainable development of the Dniester river basin signed in 2012

The basic components of the 2012 transboundary Treaty, related to the proposed case study, require the following:

- Article 6 Measures to implement the Treaty provisions. "To implement the present Treaty, the Contracting Parties (Ukraine and Moldova) shall adopt national and/or international Dniester River basin management plans, action plans, schemes and programs aimed at achieving sustainable water use, control of water pollution, prevention of adverse impacts of water, prevention and elimination of consequences of emergencies, protection of biodiversity, as well as conservation and rational use of aquatic biological resources."
- Article 19 Scientific and technical cooperation. "The Contracting Parties (Ukraine and Moldova) shall cooperate, including by way of development and implementation of joint scientific research programs and projects involving specialists from the states of both Contracting Parties and other experts, exchange of experience and technologies, regular exchange of scientific and technical information and publications, provision of information on the legislative and other normative acts, as well as other measures in the field of management of water and other natural resources and ecosystems of the Dniester River basin".

5) Please indicate the scope and mandate of these arrangements in terms of flood management (e.g. flood forecasting and warning, emergency assistance, exchange of basin hydrological data and information, joint studies, coordination of flood defence projects, coordinated flood emergency management, joint basin planning (land and water), joint Integrated Water Resources Management plans).

The Scheme for integrated flood control in basins of the Dniester, Prut and Siret rivers, 2008 was developed by Ukrainian water authorities in order to eliminate the consequences of floods and to prevent further catastrophic floods. Scientific substantiation is based on detailed analysis of the genesis, reasons and effects of floods on the rivers of the Prikarpatye region, study and generalization of the world experience concerning methods and ways of protection against harmful effects of flood water, consultations with specialists of national and international organizations. It includes technical-engineering (hydraulic-engineering), agricultural afforestation and structural (organizational) measures aimed at flood flow regulating and river training, securing reliable protection of populated areas, preventing the development of bad exogenous processes etc.

In addition, since 2005, cooperation between Ukraine and Moldova has been supported by the project "Environment and Security", which involve the OSCE, UNECE and UNEP, as well as donor governments. Since the start of the implementation of these projects, theState Water Resources Agency of Ukraine has been actively involved in the "Dniester process".

The most significant results of this process are:

- Transboundary Diagnostic Study for the Dniester River basin;
- Action Programme to improve transboundary basin water resources management;
- Development and signing of a new contract Dniester Basin in November 2012 in Rome;
- Joint Moldovan-Ukrainian hydrochemical expedition from the source to the mouth of the Dniester, which had been introduced since 1998, during which they studied the changes of state of water quality along the riverbed and made his assessment on the EU adopted a system of classes;
- Joint ichthyological survey conducted for the first time since 1992, which was devoted to the study of the state of the fish fauna of the Lower Dniester, as well as identify the most valuable parts of the waters of the Lower Dniester to ensure the viability of fish;
- Improving the exchange of information at the level of the pool and an open cross-border information system in the Dniester River Basin.

Ukraine and Moldova have developed a strategic direction of the Dniester River basin to adapt to climate change. The priority adaptation measures include measures aimed at reducing the damage caused by extreme floods, in particular:

- Improving the monitoring and forecasting of flow and exchange of information;
- Mapping of the risk of flooding;
- Inventory of protective infrastructure.

All events and meetings in the framework of the "Dniester process" and provide an opportunity to give new impetus to establish professional relationships with colleagues from the Republic of Moldova.

6) Please provide indication on what are the main factors contributing to success of those arrangements for cooperation on transboundary flood management. What are the major shortcomings in flood management cooperation and the underlying technical systems and institutional arrangements that provide support?

The main factors contributing to the success of cross-border cooperation and achieving understanding of the parties is the unity and integrity of the basin's water resources, responsibility for the events that occur in the upper reaches, which depends on the situation in the lower basin. It should be noted the close cooperation between the Hydromets Moldova and Ukraine and structures for Civil Protection and Emergency Situations of the two countries. Managing floods occur consistently among agencies of Ukraine and Moldova

The main drawback is the lack of coordination between departmental organizations in the country. For example, energy pursues its goals despite the requirements of environmental or water users. Another major issue is the political problems in Moldova and Ukraine. In both countries there are still ample opportunities to bring the control mechanisms in line with the requirements of a modern democratic society. This preserves the difficult economic situation, which makes it difficult to mobilize its own resources for the development of countries. In Ukraine, there is a strong need to resolve the military-political crisis in the south-east of the country. Transnistrian region of Moldova, which has great economic potential, remains a hotbed of political tension, in fact, beyond the control of the central government.

7) Please propose one technical area (such as provided under 4 above) or institutional area (e.g. flood management policy, law, organizational setup, finances, capacity building for specific technical areas) that you see as the key area where the flood management system could be improved in the shared basin. Please be as specific as possible.

Greater attention should be paid to flood management. In 2014 Moldova developed and adopted a government decree on flood management plan. In this context, greater attention should be paid to improving the institutional capacity of water management organizations in the management of floods on rivers. It is necessary to improve the quality of medium- and long-term forecasts of flood Feasibility Hydrometeorological Service of both countries.

8) Please provide your name and contact details or name and contact details of appropriate contact person. Please also provide references or websites where more detailed information can be found, if available.

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Ministry of Infrastructure and the Environment

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TEMPLATE FOR SUBMITTING CASE STUDIES ON TRANSBOUNDARY FLOOD ISSUES

Second workshop on Transboundary Flood Risk Management

Geneva, 19-20 March 2015

1) Name of the river basin(s) you are proposing:

The Drin-Buna river basin, Albania

2) Please shortly describe the river basin/sub-basin, basin States, climatic conditions (e.g. climate zone, precipitation amount, flood season, role of snow and ice melt in flood generation)

The catchment of the Drin–Buna rivers is an international basin shared by Albania, Macedonia, Kosovo and Montenegro. The catchment area is estimated to be 14,173 km2 with a length of 285 km. The Drin river originates from Lake Ohrid and Lake Prespa in Macedonia where it is called the Black Drini. Its upper catchment drains areas in Greece, Albania and Macedonia.

Further downstream, the White Drini River, which originates from Kosovo, converges with the River Drini. It has a length of about 136 km which drains a karstic region of nearly 4,964 km² within Albania and 4,360 km² in Kosovo with a mean elevation of 862 m. Rainfall is highly variable and an annual average of up to 1500mm is reported.

The Gjadri and Kiri rivers join the Drini downstream at the Vau Dejes Dam and have catchment areas of 200 km2 and 264 km2 respectively. Further downstream the Drini converges with the outflow from Shkodra Lake and becomes the Buna River. It continues along the border with Montenegro until it enters the Adriatic Sea.

The Shkodra lake is the largest lake in the Balkan Peninsula in terms of water surface area. It has a catchment area of about 5,500 km2 (of which 80% is in Montenegro and 20% in Albania) and the surface area varies between 353 km2 in dry periods and 500 km2 in wet periods. The main inflow to Lake Shkodra is the Moraca River, which supplies the lake with approximately 66% of its water.

The full Drini-Buna catchment area has a Mediterranean/Continental climate characterized by a dry and warm long summer and humid winter with levels varying from sea level in the Shkodra Lowlands to 2500 mASL in the Albanian Alps in the north west of the catchment, and 2700 mASL in the mountains to the east of the Black Drini.

The Lake Shkodra basin receives an average annual precipitation of 2060 mm, with over 3000 mm in parts of the catchment.

3) What types of floods affect the river basin (riverine/fluvial floods, flash floods/pluvial floods, coastal floods, groundwater floods, flooding related to reservoir operation, etc.)? Please provide a short account of the major flood events that have affected the basin in the past decade(s) as well as their impacts (e.g., in terms of losses of live, damages to property and overall economic losses). If possible, please indicate how many of the basin States were affected by each event.

The most important cause of floods is excessive rain. Rain may be seasonal occurring over wide areas, or from localised storms which produce the highest intensity rainfall. Melting snow is another major contributor to floods. The floods are flash and resulting from an increase in streamflow beyond the point where the normal stream channel can contain the water. When water overspills riverbanks, it spreads out along the adjoining floodplain.

There also are a number of large hydropower plants (HPP) on the Drini river in Macedonian and Albanian area. The hydrologic response of the Drini catchment is strongly influenced by the cascade of three hydropower (dams are at Fierza, Koman and Vau Dejes).

In 2010, heavy rainfall in the catchments led to flooding of an estimated 14,500 ha of farmland and settled areas including the city of Shkodra, within Shkodra Prefecture.

It has been reported that 4,600 houses have been directly affected by the flooding, causing the evacuation of some 12,145 people. A further 14,646 livestock were also evacuated during the peak period of flooding.

The overall estimation of flood damage during December, 2010 was calculated over €60 000 000. More than 75% of the population of NenShkoder and 25% of the population of the city has been directly affected from the inundation consequences. The percentage is thought to be even higher if included the indirect impact caused by floods. No deaths or casualties directly related to the flooding have been reported.

During the flooding of 2010, are also flooded some area in Montenegro from the increased level of Shkodra Lake and of Buna River as well.

4) Please provide information on arrangements that provide a basis for cooperation in terms of flood management in the basin, such as bi- or multilateral agreements and institutions (e.g. river basin organizations).

The water sector in Albania is still relatively in a chaos situation from both administrative and implementation point of view. The water administration has been managed by Ministry of Environment since 2010 leading thus the policies and strategies of the sector. Very recently Water Administration is delegated to the Ministry of Agriculture, Rural Development and Water Administration. Initially in December 2009 the Drin Dialogue was lunched 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. This MoU was signed in Tirana on 25 November 2011.

Using this agreement as an entry point as well as with the request of Albanian and Montenegrin government after flooding 2010, German Government through GIZ supported the project Climate Change Adaptation in Western Balkans, which has an extended focus on Drin Basin.

The above mentioned project has 5 components and two of them are addressing flood management. Whilst in local level GIZ is supporting the drafting and implementation of 8 Flood Risk Management Plans in lower Shkodra, Albania and 5 in Montenegro, in regional level the project has established the good basis for an regional Flood Early Warning System for Lower Drini- Buna. This component embed the close cooperation among 4 institutes responsible for Hydro-meteorological services of Macedonia, Kosovo, Albania and Montenegro.

In addition to the above mentioned, Albanian and Montenegro Governments have intensified their collaboration in the field of water management and recently a draft agreement between two governments is under consideration.

5) Please indicate the scope and mandate of these arrangements in terms of flood management (e.g. flood forecasting and warning, emergency assistance, exchange of basin hydrological data and information, joint studies, coordination of flood defence projects, coordinated flood emergency management, joint basin planning (land and water), joint Integrated Water Resources Management plans).

In 10-11 September 2012 a round table is organised in Tirana with representatives of Ministries of Environments of the 4 countries (Al, MK, XK & MNE) and Hydrometeorolocigal institutes of all 4 countries as well as Foreign experts from the DG Joint Research center, World Meteorological Organisation and hydro power company in Germany were also invited in the round table. It served as a startup 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. In order to have a robust DEWS it is considered as of high importance the set up and improvement of national early warning systems first having in mind real time data and meteorlogical and hydrological forcasting models and than interconnect different components in DEWS.

Once the agreement was reached during June – July 2013 an expert mission was organised in all 4 countries for the specification of the hydro-meteorological equipment is needed for the EWS. During 2014, preparation of locations and installation of 32 automatic stations is done in all basin out of which 4 meteorological and 5 hydrological stations are placed in Albania. From September 2014, real time data access is available in all 4 countries for the first time.

In order to serve to the Early Warning System as well as support hydromed services staff with the modelling and forecasting, all 4 HMI has been presented and offered with the Hydrological modelling Panta RHEI. Upon interest of the partners, three German experts have been contracted to construct Panta RHEI model for the Drin Basin. Several trips to countries are organized from December 2013 – up to now to collect data and the necessary information for the model

The work done on the hydrological model for Drin is accompanied with several training sessions and a study visit.

Simulation of hydrological scenarios is tested and showed to the respective staff of all 4 institutes. Now the model is in the calibration process.

Parallel with this calibration work, which will need at least 6 months of real time database, with the support of GIZ – Climate Change Adaptation in Western Balkans project a regional discussion on data sharing between 4 institutes responsible for the Hydro - meteorological services is being done. A first draft of MoU is prepared and sent for comments.

Additionally the project has supported all 4 institutes to establish links with EFAS (European Flood Awareness System). Albania and Montenegro are in the meantime members of EFAS and do profit from their awareness service, while both Kosovo and Montenegro are in the process of membership.

In the meantime with the extreme weather events of January-February 2015 there has been and increased exchange between experts of all 4 countries to support Albania in better forecasting.

6) Please provide indication on what are the main factors contributing to success of those arrangements for cooperation on transboundary flood management. What are the major shortcomings in flood management cooperation and the underlying technical systems and institutional arrangements that provide support?

Even though Flood management is of a vivid importance, especially for countries in the lower side of the basin, the results achieved so far would have been doubtful without the technical and financial support of GIZ.

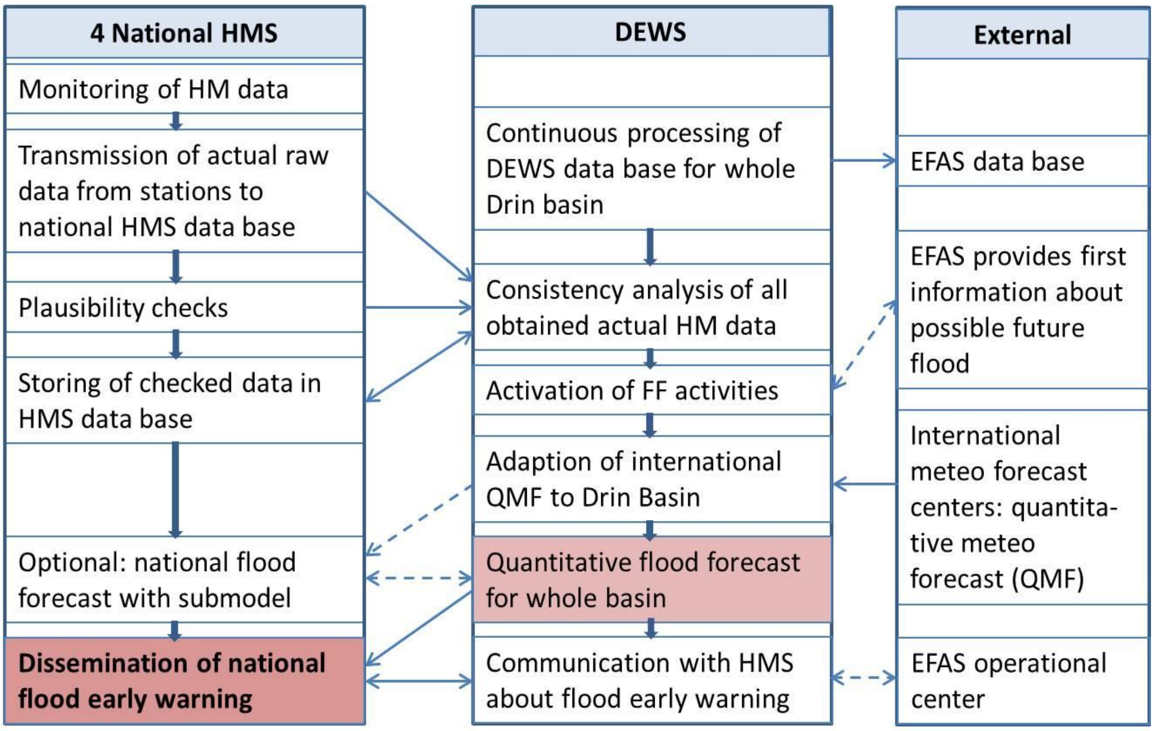
It should be underlined that a successful cooperation needs a long term commitment by the donor side, especially under the conditions of limited staff and budget from institutes.

In addition all institutes do have limited capacities in terms of expertise which is needed for forecasting and data management. This is a process that requires time and what is more important preparation of the new generation.

7) Please propose one technical area (such as provided under 4 above) or institutional area (e.g. flood management policy, law, organizational setup, finances, capacity building for

specific technical areas) that you see as the key area where the flood management system could be improved in the shared basin. Please be as specific as possible.

What is presented above is only the start for a robust regional EWS for Drin – Buna basin. As proposed by GIZ experts in order to have a functional DrinEWS there should be a very good interaction of the national and trans-boundary level.



Whilst the steps under the first column are being continuously supported by GIZ, for the successful implementation of the other two ones an additional funding and technical assistance is needed. At least 2 mln Euro would be needed in a time frame of 3 additional years so that the work done is finalised and the results remain sustainable.

All 4 institutes have expressed their appreciation on the approach followed so far , but in the same time are of the opinion that Flood management should also be considered by the institutions in charge for planning.

8) Please provide your name and contact details or name and contact details of appropriate contact person. Please also provide references or websites where more detailed information can be found, if available.

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TEMPLATE FOR SUBMITTING CASE STUDIES ON TRANSBOUNDARY FLOOD ISSUES

Second workshop on Transboundary Flood Risk Management

Geneva, 19-20 March 2015

1) Name of the river basin(s) you are proposing:

Ganges-Brahmaputra and Meghna River Basins.

2) Please shortly describe the river basin/sub-basin, basin States, climatic conditions (e.g. climate zone, precipitation amount, flood season, role of snow and ice melt in flood generation)

The Ganges Brahmaputra Meghna (GBM) basins are shared by China, Nepal, Bhutan, India and the lowermost riparian country Bangladesh, having a total area of about 1.72 million sq km, with the Ganges having the biggest part (1,087,000 sp km; Brahmaputra: 552,000 sp km; Meghna: 82,000 sq km). The three basins may be divided into 133 sub-basins, of which 79 sub-basins are located in the Ganges basin, 47 in the Brahmaputra basin and the rest (7) in the Barak-Meghna basin. While addressing Flood Risks in Bangladesh, the contributions from these sub-basins are important. Their exact contribution, however, cannot be assessed due to paucity of data. It may be mentioned that there are 57 transboundary rivers in Bangladesh, of which 54 enter Bangladesh from India and the rest three from Myanmar.

The GBM Basins are located in a humid sub-tropical climate. The Himalayas in the north and the Bay of Bengal in the south influence the climatic conditions significantly. The monsoon rainfall in the upper basin countries and in Bangladesh generates huge runoff causing floods, river erosion and related disasters in Bangladesh. In Bangladesh, the hydrological year is divided into four seasons: the relatively dry and cool winter from December through February; the dry and hot summer from March to May; the monsoon (rainy season) from June to September and sometimes through to October, when most of the rains occur in the basins including Bangladesh, causing the majority of the floods; and the retreating monsoon of October and November, also known as spring. The depression in the Bay of Bengal during April-May and October-November generates cyclonic storms with very high velocities of winds and heavy rainfall causing huge coastal flooding and associated damages.

The rainfall over the whole basins varies widely both in aerial distribution and intensity, even in the same basin and also from basin to basin. Within Bangladesh, the rainfall variation is relatively small compared to the upper riparian countries, as almost the whole of Bangladesh falls within the influence of the south-west monsoon during rainy seasons. The average annual rainfall varies from about 1,700 mm in the North-West to about 4,000 mm in the North-East, with an average of 2,200 mm annual rainfall. The major rainfall occurs during June to September, with an occasional prolonged dry spell during November to April-May, which causes drought and which affects crop production through highly reduced flows in many transboundary rivers, as upstream water abstraction also increases due to higher demands.

3) What types of floods affect the river basin (riverine/fluvial floods, flash floods/pluvial floods, coastal floods, groundwater floods, flooding related to reservoir operation, etc.)? Please provide a short account of the major flood events that have affected the basin in the past decade(s) as well as their impacts (e.g., in terms of losses of live, damages to property and overall economic losses). If possible, please indicate how many of the basin States were affected by each event.

Floods in Bangladesh are a regular phenomenon. About 60% of the country is flood prone, while 18-20% of the land area is inundated by monsoon rains in normal years. The main factors responsible for floods in Bangladesh is an onrush of huge transboundary flows plus in-country generated runoff due to intense rainfall of prolonged durations. Floods are caused by over spilling of the major rivers, surface runoff which cannot be drained out quickly either due to reduced conveyance capacity of silted up river systems, low gradients of the rivers, and due to high tides/water levels in the sea (in the Bay of Bengal), causing slow drainage or drainage congestion. It is anticipated that snow melt in the Himalayas is also contributing to floods in upstream countries as well as downstream Bangladesh, but its magnitude has not been assessed.

Floods in Bangladesh may be categorized into four main types: monsoon floods, flash floods, localized rain floods and coastal storm surge floods and inundations. During the monsoon, urban floods of both fluvial and pluvial nature are being observed at an increasing rate in Bangladesh due to a number of reasons. A preliminary study with limited data (some cases assumed data) has shown that operation of upstream reservoirs has limited impacts on flooding in Bangladesh.

The monsoon floods are synonymous to river floods. River floods during the monsoon are the most common and closely related to rainfall in the basin and in-country rainfall. Intense local and short-lived rainfall often associated with mesoscale convective clusters is the primary cause of flash floods, and the flash flood-prone areas of Bangladesh are located at the foothills. These are characterized by a sharp rise in flows followed by a relatively rapid recession, often associated with high flow velocities which damage crops, properties and fish stocks of the wetlands. Flash floods can occur within a few hours. In the months of April and May, they affect the rice crop at the harvesting stage, and are common in the North-East and South-East regions of the country. The exposed surface is eroded during the intense rainfall in the hilly area, and sediments are transported from the overland flow into the rivers, and then further downstream into the river system. The erosion also takes place in the river system, and structures and properties are damaged by the strong current, while sediment deposition occurs in areas where the flow slows down. Sediment depositions reaching 4-5 meter height have been recorded in some locations, causing reduced transport capacity of the river system and water logging in low-lying areas.

Localized floods are increasing due to constraints created to natural drainage systems by human interferences e.g. construction of unplanned roads, infrastructures and encroachment of existing drainage channels and river courses etc., or due to the gradual decay of the natural drainage systems. When intense rainfall takes place in those areas, the natural drainage system cannot function properly and cannot carry the run-off generated by the storm, which causes temporary inundation in many localities. This kind of rain-fed flood is increasing in the urban areas.

Cyclone induced floods mostly occur along the coastal areas of Bangladesh. Cyclonic storms in the order of 220 km/hour may generate surges with heights of 10 m and above, causing flooding in the entire coastal belt. The worst kind of such flooding occurred on 12th Nov 1970 and 29th April 1991, causing the loss of 300,000 and 138,000 human lives, respectively. The coastal floods of 2007 and 2009 in Bangladesh are also worth mentioning. Coastal areas are also subjected to tidal flooding during the months from June to September, when the sea is in spate due to the Southwest monsoon.

In the 19th century, six major floods were recorded in 1842, 1858, 1871, 1875, 1885 and 1892. Eighteen major floods occurred in the 20th century. The floods of 1954, 1955, 1987, 1988, 1998, 2004 and 2007 were of catastrophic type. These floods affected about 35-68% of the land area. A historical overview of floods since 1954 indicates that the frequency, magnitude, and duration of floods have increased substantially, probably due to climate change.

4) Please provide information on arrangements that provide a basis for cooperation in terms of flood management in the basin, such as bi- or multilateral agreements and institutions (e.g. river basin organizations).

There is no overall transboundary arrangement for cooperation in terms of flood management in the GBM basins. Between Bangladesh and India, however, an "Agreement…on sharing of the Ganges waters at Farakka and on augmenting its flows" (signed in 1977 and amended in 1996, with two MoU dating 1983 and 1985) exists, This agreement does not cover flood risk management, bun mentions in the preamble that "both countries wish to share the waters of international rivers and optimally utilize the water resources of the region in the field of flood management, irrigation, river basin development and hydropower generation for the mutual benefit of the people of the two countries".

In 2010, a memorandum was signed at the ministerial level of the two governments, to collaborate and co-operate each other on the issue of flood risk management.

Bangladesh and India have also signed a Framework Agreement on "Cooperation for Development" in September 2011. For flood risk management, the following cooperative measures should be taken:

- Data sharing on flood management.
- Intervention through infrastructure development like control and regulating structures in the upper riparian countries.
- Construction of infrastructures in appropriate location of the riparian countries.
- Proportionate joint investment by riparian countries may be explored for joint investment.

5) Please indicate the scope and mandate of these arrangements in terms of flood management (e.g. flood forecasting and warning, emergency assistance, exchange of basin hydrological data and

information, joint studies, coordination of flood defence projects, coordinated flood emergency management, joint basin planning (land and water), joint Integrated Water Resources Management plans).

According to the 2010 memorandum, the Central Water Commission (CWC) of India delivers water level and rainfall data to the Flood Forecasting and Warning Center (FFWC) of Bangladesh at 4 different stations in a frequency of 2 times per day. This data has been used in models for regional and national flood forecasting of along the Brahmaputra basin as well as dependent river of Brahmaputra river system.

6) Please provide indication on what are the main factors contributing to success of those arrangements for cooperation on transboundary flood management. What are the major shortcomings in flood management cooperation and the underlying technical systems and institutional arrangements that provide support?

It has been observed that receiving flood level data from at least two upstream stations early on helps to provide a reliable forecast with 3 day lead time for both the Ganges and Brahmaputra in Bangladesh. Normally, however, Bangladesh gets the information for only one upstream gauging station through official arrangement, and for other stations only by assessing the respective websites (exception is India after the 2010 MoU). Therefore, if it is possible to get flood level data for 2 or more upstream stations, forecasts with more lead time would be possible. Hence, a major shortcoming is timely availability of flood data and information from upstream river basins. This may be partly overcome by developing a joint flood management pilot project in the Ganges and Brahmaputra river basins. The outcome of this pilot project would provide valuable information and data for downstream countries though a joint study, which ideally would be possible without any formal treaties and agreements. Successful transboundary flood management cooperation depends above all on understanding and respecting the problems and needs of downstream partners.

7) Please propose one technical area (such as provided under 4 above) or institutional area (e.g. flood management policy, law, organizational setup, finances, capacity building for specific technical areas) that you see as the key area where the flood management system could be improved in the shared basin. Please be as specific as possible.

Joint flood forecasting, flood warning and exchange of data would be a key area where the flood management system could be improved in the GBM basins. A step-by-step approach to gain political support is needed. The Convention requires that parties cooperate in research and development and that they exchange information on water quantity and quality. Parties are required to establish joint monitoring 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 institute to provide forums for discussing planned flood prevention measures and agreeing on possible joint measures. Finally, parties should assist each other – for example, in case of flood forecasting and warning in the GBM Basins.

8) Please provide your name and contact details or name and contact details of appropriate contact person. Please also provide references or websites where more detailed information can be found, if available.

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TEMPLATE FOR SUBMITTING CASE STUDIES ON TRANSBOUNDARY FLOOD ISSUES

Second workshop on Transboundary Flood Risk Management

Geneva, 19-20 March 2015

1) Name of the river basin(s) you are proposing:

Hermance and Marquet-Gobé-Vengeron Transboundary basins, France - Switzerland

2) Please shortly describe the river basin/sub-basin, basin States, climatic conditions (e.g. climate zone, precipitation amount, flood season, role of snow and ice melt in flood generation)

The French part of the basin is upstream and is characterized by agriculture and forestry (mountainous) areas. The Swiss part of the basin is downstream and is highly urbanized. In both areas there is strong development and population pressure on the entire basin

3) What types of floods affect the river basin (riverine/fluvial floods, flash floods/pluvial floods, coastal floods, groundwater floods, flooding related to reservoir operation, etc.)? Please provide a short account of the major flood events that have affected the basin in the past decade(s) as well as their impacts (e.g., in terms of losses of live, damages to property and overall economic losses). If possible, please indicate how many of the basin States were affected by each event.

Floods overflow

- Marquet-Gobé-Vengeron floods in November 2003 and March 2001
- Foron floods in November 1996, June 1990, January 1979, June 1974
- Hermance: Flooding in January 1979

No human loss, but property damage

4) Please provide information on arrangements that provide a basis for cooperation in terms of flood management in the basin, such as bi- or multilateral agreements and institutions (e.g. river basin organizations).

The State of Geneva is responsible for implementing Swiss policy of integrated water management by watershed. However, the vast majority of the Geneva rivers originate from French territory. Thus, fifteen years ago, the state of Geneva adopted a cross-border approach to the management of its rivers, coupled with an implementation policy of mixed projects combining protection against floods, restore natural environments and enhancement of public spaces.

1997: Transboundary Agreement Protocol for the revitalization of rivers Franco-Geneva. 1995 to 2004: Signature of five contracts involving transboundary rivers French State and its partners and the Canton of Geneva.

5) Please indicate the scope and mandate of these arrangements in terms of flood management (e.g. flood forecasting and warning, emergency assistance, exchange of basin hydrological data and information, joint studies, coordination of flood defence projects, coordinated flood emergency management, joint basin planning (land and water), joint Integrated Water Resources Management plans).

As mentioned, there are 5 cross-border rivers agreements. The agreement is a technical and financial agreement framing an action program for the restoration and enhancement of aquatic environments covering the entire watershed. This is a real tool for integrated water resources management. Developed in collaboration, the contract of transboundary rivers financially committed both the State of Geneva and the French authorities to carry out joint flood retention measures. The river agreements helped implement practical management of transboundary waters. For example:

In the watershed Marquet-Gobé-Vengeron three retention ponds were built between 2005 and 2008, both located on French territory and one in Switzerland. The cost of a total of 1,631,000 Euros was supported by the Swiss and French partners river contract. Retention capacity created at the three sites is 60,000 m3. These achievements have helped protect flood all urbanized areas downstream. In addition, from the design of these projects, biological and social objectives have been included such as the creation of wetlands and the construction of walking paths. The management of earth materials has also been developed so as to reuse the land there and improve the quality of the surrounding farmland.

Another example is that of protecting the Swiss village of Hermance, located on the eponymous river. Here, the river serves as a national border with a Swiss bank heavily urbanized and subjected to flooding and 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 flooding. This project has also made a strong biological added value with the restoration of the mouth of the Hermance and recovery of diverse natural environments. The total cost of the project amounts to 330,000 Euros divided between the Swiss and French partners of the contract.

6) Please provide indication on what are the main factors contributing to success of those arrangements for cooperation on transboundary flood management. What are the major

shortcomings in flood management cooperation and the underlying technical systems and institutional arrangements that provide support?

The Geneva Experience has shown that cross-border collaboration allows for cost savings while improving safety and comprehensively environment. For example, in the transboundary sections of the rivers, a non-coordinated policy would have led each country to take specific measures to protect against flooding (dykes, walls), pushing the problem on the other side or downstream. However, French-Swiss cooperation helped protect homes subject to flooding on both sides of the border while providing the public with quality public spaces and restoring the space required for biological function of the river.

However, work and act across borders requires a permanent effort of coordination and communication in order to establish common objectives and financial allocations. 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 giving means of implementation.

Success factors included:

- Shared political will of practical cooperation
- Financial and human resources available
- Implementation of cooperation in the field by technical coordination
- Joint implementation and effective communication

7) Please propose one technical area (such as provided under 4 above) or institutional area (e.g. flood management policy, law, organizational setup, finances, capacity building for specific technical areas) that you see as the key area where the flood management system could be improved in the shared basin. Please be as specific as possible.

A key area for improving the management of transboundary water is the awareness and leadership to facilitate working for the long-term security for people and property against floods.

8) Please provide your name and contact details or name and contact details of appropriate contact person. Please also provide references or websites where more detailed information can be found, if available.

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TEMPLATE FOR SUBMITTING CASE STUDIES ON TRANSBOUNDARY FLOOD ISSUES

Second workshop on Transboundary Flood Risk Management

Geneva, 19-20 March 2015

1) Name of the river basin(s) you are proposing:

Logone River, Lake Chad Basin

2) Please shortly describe the river basin/sub-basin, basin States, climatic conditions (e.g. climate zone, precipitation amount, flood season, role of snow and ice melt in flood generation)

The Lake Chad watershed is a vast inland basin of about 2,388,700 km2 covering almost all of Chad (1,091,500 km2), part of Cameroon (46,800 km2), Nigeria (180,200 km2), Niger (674,000 km2), Sudan (82,800 km2), Central African Republic (218,600 km2), Libya (4,600 km2) and Algeria (90,000 km2).

The Chari-Logone system is the biggest supplier of water flowing into the lake. It comprises of two major courses: the River Chari and the Logone River. The Chari-Logone River basin area is approximately 650 000 km and the Chari River extends 1 400 km. The Chari and Logone rivers have a tropical regime with a single flood occurring at the end of the rainy season, which lasts from August to November and feeds the extensive Waza-Logone floodplains and Yars. The floodwaters take between one and two months to reach the southwest shore of Lake Chad. The flow is at its minimum in May/June at the beginning of the following years rainy season. However, in the last 40 years the mean Chari discharge has decreased significantly because of the persistent change in rainfall patterns over the contributing catchment.

The Logone flood plains occupy about 25 000 km, the largest area of the Waza-Logone floodplain and the most important being the Grand Yars with a surface area of 8 000 km.

3) What types of floods affect the river basin (riverine/fluvial floods, flash floods/pluvial floods, coastal floods, groundwater floods, flooding related to reservoir operation, etc.)? Please provide a short account of the major flood events that have affected the basin in

the past decade(s) as well as their impacts (e.g., in terms of losses of live, damages to property and overall economic losses). If possible, please indicate how many of the basin States were affected by each event.

The last major occurred in 2012.The period from July to September 2012 was marked by the strong precipitation in the basin of Chari-Logon. Many areas of the basin were flooded by rain water. Chari and Logon, two principal rivers overflowed in various places.

The floods affected more than 6 areas of Chad and five municipal districts of the town of Ndjamena. The damage was evaluated with 542123 affected people, 255719 hectares of flooded cultures as well as schools, centers of health, roads, bridges and dams, and tens of hundreds of houses were destroyed. In the town of Kousserie the dam protecting the area collapsed.

In the department of Mayo Danay, the dam protection separating Logon and the lake Maga on meadows from 200 m, was threatened by water, obliging the inhabitants of Pouss to move in another village.

4) Please provide information on arrangements that provide a basis for cooperation in terms of flood management in the basin, such as bi- or multilateral agreements and institutions (e.g. river basin organizations).

Within the framework of the risk management of transboundary floods, the Republic of Cameroun and the Republic of Chad, anxious to develop their economy rural signed the Convention of creation of the Mission of Installation of Logone. The mission has as an aim the implementation of the agreements made between the Republic of Chad and the Republic of Cameroun and to ensure the study and the execution of the projects of installation of the basin of the Logone river. Unfortunately the draft-agreement was not respected and the Mission of installation did not function as it should be for lack of ratification by the two parts. Within the framework of the co-operation and risk management of transboundary floods, the projects of installation for the protection of the villages and the cultures were carried out on both sides in the two countries.

5) Please indicate the scope and mandate of these arrangements in terms of flood management (e.g. flood forecasting and warning, emergency assistance, exchange of basin hydrological data and information, joint studies, coordination of flood defence projects, coordinated flood emergency management, joint basin planning (land and water), joint Integrated Water Resources Management plans).

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 (Chari, Logone and others), 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 or.

During situations of flood in progress or to come, the States Parties aim to:

a) to manage the hydraulic works so as to decrease the risk or not to increase it;

b) to set up any action likely to inform the populations as soon as possible and to minimize the impacts of the floods.

The States Parties begin in particular to inform each year, on the basis of analysis of the hydrogrammes of believed of Chari and Logone, the bordering populations of the Lake of the maximum level which the dimension of the Lake will be able to reach.

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. To this end Chad and Cameroun like the other countries will profit from certain projects of flood works:

In Chad

- Creation of an environment entitling to the placement of the Integrated Management of Resources Water and of the grounds;
- Support with the development and the implementation of an action plan of risk management and catastrophes;
- Creation of a mechanism and an operational structure of risk management.
- Protection and maintenance of the banks of Logone

In Cameroon:

- Expand the governance of floodplains of the Logone and safeguard of its values;
- Rehabilitation of the dam Maga and consolidation of the governance of its natural resources.
- Protection and maintenance of the banks of Logone.

6) Please provide indication on what are the main factors contributing to success of those arrangements for cooperation on transboundary flood management. What are the major shortcomings in flood management cooperation and the underlying technical systems and institutional arrangements that provide support?

The political good-will and the organization of the two countries vis-a-vis the transborder floods help to reduce impacts during flood events. Barriers are due to the lack of consequent means to translate the mentioned political will into concrete action.

7) Please propose one technical area (such as provided under 4 above) or institutional area (e.g. flood management policy, law, organizational setup, finances, capacity building for specific technical areas) that you see as the key area where the flood management system could be improved in the shared basin. Please be as specific as possible.

The two countries have agreed to build more water monitoring and control structures on the tributaries of the Benue, as well as to establish a framework for the exchange of hydro-meteorological and environmental data. They will carry out joint technical site visits, studies and research, and set up an early warning and response mechanism.

8) Please provide your name and contact details or name and contact details of appropriate contact person. Please also provide references or websites where more detailed information can be found, if available.

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TEMPLATE FOR SUBMITTING CASE STUDIES ON TRANSBOUNDARY FLOOD ISSUES

Second workshop on Transboundary Flood Risk Management

Geneva, 19-20 March 2015

1) Name of the river basin(s) you are proposing:

Nile River Basin

2) Please shortly describe the river basin/sub-basin, basin States, climatic conditions (e.g. climate zone, precipitation amount, flood season, role of snow and ice melt in flood generation)

The river Nile is one of the oldest rivers on the planet (more than six million years). The Nile is very special in its characteristics. It is the longest river in the world, of about 6,500 kilometers length. The Nile basin area is around three million square kilometers in size, is situated in many different countries with a variety of different characteristics. The main water supply sources for the Nile are the equatorial lakes, the Bahr El-Gazal Watershed and the Ethiopian Plateau. The Nile has two major tributaries, the White Nile and the Blue Nile. The White Nile is considered to be the headwaters and primary stream of the Nile itself. The Blue Nile, however, is the source of most of the water and fertile soil. The White Nile is longer and rises in the Great Lakes region of central Africa, with the most distant source still undetermined but located in either Rwanda or Burundi. It flows north through Tanzania, Lake Victoria, Uganda and South Sudan. The Blue begins at Lake Tana in Ethiopia and flows into Sudan from the southeast. The two rivers meet near the Sudanese capital of Khartoum.

The different characteristics of the different watersheds are affecting the Nile flow to a large extent. Some of these differences are the topographic differences, climatic and seasonal differences (it passes equatorial and desert climate zones, with the flood season mainly in the summer season, as all of the flow of the Nile is coming from rains, no snow melt contribution), in addition to different losses along the Nile course. All of previously mentioned factors are integrated together, for different Nile water sources, to form the Nile water flood. The highest recorded flood value for the natural river at Aswan was 150 billion cubic meters per year (reported in 1878-1879) and the lowest recorded value was 42 billion cubic meters per year (reported in 1913-1914). This great variation makes flood forecasting in the Nile River more difficult.

3) What types of floods affect the river basin (riverine/fluvial floods, flash floods/pluvial floods, coastal floods, groundwater floods, flooding related to reservoir operation, etc.)? Please provide a short account of the major flood events that have affected the basin in the past decade(s) as well as their impacts (e.g., in terms of losses of live, damages to property and overall economic losses). If possible, please indicate how many of the basin States were affected by each event.

The Nile floods are riverine floods and reservoir operation. One of the largest recent floods occurred in 1998-1999, it caused overtopping of some houses and cultivated lands and loss of prosperities. This was mainly on Egypt and Sudan.

Flood events and flow records are characterized and categorized into into the following five categories:

1-Very low flood (52, or less, billion cubic meters per year).

2-Low flood (70 billion cubic meters per year).

3-Average flood (92 billion cubic meters per year).

4-High flood (110 billion cubic meters per year).

5-Very high flood (exceeding 110 billion cubic meters per year).

4) Please provide information on arrangements that provide a basis for cooperation in terms of flood management in the basin, such as bi- or multilateral agreements and institutions (e.g. river basin organizations).

The proposed cooperations are various, of which the most important part is sharing the flood data among states, which is essential for studying flood and flood management. The second part is sharing reservoir flood management between Egypt and Sudan, as defined by the 1959 treaty between the two countries. The third cooperation is the technical cooperation and capacity building and sharing information for flood management and flood protection.

5) Please indicate the scope and mandate of these arrangements in terms of flood management (e.g. flood forecasting and warning, emergency assistance, exchange of basin hydrological data and information, joint studies, coordination of flood defence projects, coordinated flood emergency management, joint basin planning (land and water), joint Integrated Water Resources Management plans).

The scope of performed work is mainly the protection of eroded and/or flooded area during high floods. The approach has been applied for long lengths in Egypt and has proved its efficiency, and it is proposed to be applied in other states.

6) Please provide indication on what are the main factors contributing to success of those arrangements for cooperation on transboundary flood management. What are the major shortcomings in flood management cooperation and the underlying technical systems and institutional arrangements that provide support?

The main factors of success are the good agreements among countries especially with regard to data sharing and capacity building. In addition, the existence of formal agreements and treaty such as 1959 treaty between Egypt and Sudan are important success factors. More technical support for other Nile basin countries is required, and it is necessary to receive more attention from international support agencies.

7) Please propose one technical area (such as provided under 4 above) or institutional area (e.g. flood management policy, law, organizational setup, finances, capacity building for specific technical areas) that you see as the key area where the flood management system could be improved in the shared basin. Please be as specific as possible.

I would consider the capacity building is the key area in Nile River basin: capacity building regarding flood forecasting and warning systems, water management, flood protection, GIS and RS usage for flood prediction and protection.

8) Please provide your name and contact details or name and contact details of appropriate contact person. Please also provide references or websites where more detailed information can be found, if available.

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TEMPLATE FOR SUBMITTING CASE STUDIES ON TRANSBOUNDARY FLOOD ISSUES

Second workshop on Transboundary Flood Risk Management

Geneva, 19-20 March 2015

1) Name of the river basin(s) you are proposing:

Panj River Basin (the upper part of the Amu Darya).

2) Please shortly describe the river basin/sub-basin, basin States, climatic conditions (e.g. climate zone, precipitation amount, flood season, role of snow and ice melt in flood generation)

The Panj River is located on the territories of Afghanistan and Tajikistan. It is a tributary of the Amu Darya River, which forms the border between Afghanistan and Tajikistan (together with the river Pamir). The Panj has a length of 921 km (total length of Vachan-Darya and Panj is 1,137 km), with a basin area of about 107,000 km². Average annual runoff is at 1,010 m³/s. Downstream of the confluence of the Vachan-Darya and the Pamir, the Panj incorporates from the Tajik side such major tributaries as the Gunt Bartang Yazgulem, the Vanj and Kyzylsu, and from the Afghan side the rivers Kokcha and Kunduz.

The Panj´s drainage basin is located in the mountains, with elevations of 5,000-7,000 m, carrying on their slopes glaciers and permanent snow packs, which play an important role in the hydrological regime of the Panj. The period of maximum runoff and flooding occurs from June to August, when intensive melting of glaciers leads to glacial lake outburst events. Hence, the rapid melting of snow cover are the main causes of flooding on the river Panj, although devastating floods on the river Kyzylsu, in the sub-basin of the Panj, are also triggered by heavy rains in the spring.

3) What types of floods affect the river basin (riverine/fluvial floods, flash floods/pluvial floods, coastal floods, groundwater floods, flooding related to reservoir operation, etc.)? Please provide a short account of the major flood events that have affected the basin in the past decade(s) as well as their impacts (e.g., in terms of losses of live, damages to property and overall economic losses). If possible, please indicate how many of the basin States were affected by each event.

Over the past decade (2004-2014.), serious floodings along the river Panj took place in the years 2003, 2004, 2005, 2010 and 2012. In June 2005, due to a failure of the flood protection embankment on the river Panj, the flood district Hamadoni in Tajikistan suffered strongly, and 10,000 people had to be evacuated. In Afghanistan, the number of residents living along the river Panj that are subject to the threat of flooding is very large, and material damages are very high.

In May 2010, in the river basin of the Kyzylsu floods and mudslides occurred in Sai Tebalay which resulted in the destruction of homes and irrigated land in the district of Kulob and Vose. As a result of advances and the possible formation of a glacier lake in the valley of the Vanj there is a rising threat of periodical flooding. In modern times, glacier advances occurred in 1973, 1989, 2001 and 2011.

4) Please provide information on arrangements that provide a basis for cooperation in terms of flood management in the basin, such as bi- or multilateral agreements and institutions (e.g. river basin organizations).

Between Afghanistan and Tajikistan, an agreement was signed in 2010 on cooperation in the field of water resources. The agreement also covers the issue of monitoring and controlling floods. In 2014, the competent authorities of the countries signed a memorandum on the exchange of hydrological information, including prevention and cooperation on forecasting and flood flow. At the regional level, the National Hydrological and Meteorological Service (NHMS) of Tajikistan is working with other NMHSs, as well as with the Committee of Emergency Situations of Tajikistan. Also in 2014, a regional workshop on the management of risks associated with extreme weather events was held in Almaty.

5) Please indicate the scope and mandate of these arrangements in terms of flood management (e.g. flood forecasting and warning, emergency assistance, exchange of basin hydrological data and information, joint studies, coordination of flood defence projects, coordinated flood emergency management, joint basin planning (land and water), joint Integrated Water Resources Management plans).

The existing agreements and processes cover the exchange of hydrological data and information, joint research and evaluation, and the exchange of prognostic data and products. In 2014, on the border of Afghanistan and Tajikistan, the interstate hydrological station Ayvadzh was constructed, which covers the upper Amu Darya river (downstream of the confluence), as well as the rivers Vakhsh and Panj. The station is currently in test mode. Plans for future cooperation include joint basin planning. Along the line of emergency, the two countries have their own interaction and mutual assistance, also via direct channels.

6) Please provide indication on what are the main factors contributing to success of those arrangements for cooperation on transboundary flood management. What are the major shortcomings in flood management cooperation and the underlying technical systems and institutional arrangements that provide support?

The success factors are:

i. The mutual interest of both countries to exchange information, establish contacts and discuss common themes, and

ii. ii. the fact that the dynamics of the cooperation coincide with the general economic and political interests of the two countries.

Shortcomings and challenges are due to the complexity of the region: i. the region is very diverse in its historical context, and a complex terrain for donors to collaborate and participate in the work, and ii. there is a (still unsatisfied) need for real synergies with the planning authorities and the implementation of other projects (especially at national level), i.e. a clearer separation of responsibilities between the regional/basin-wide level and the local/national levels would be necessary to solve the problems.

7) Please propose one technical area (such as provided under 4 above) or institutional area (e.g. flood management policy, law, organizational setup, finances, capacity building for specific technical areas) that you see as the key area where the flood management system could be improved in the shared basin. Please be as specific as possible.

Possible steps include: First, it would be necessary to establish a permanent and sustainable process of exchanging hydrological data and forecasts and flood warnings - both from a technically from a practical point of view. This would require a combination of institutional reform/work (such as the automation of observations, or the access to the border areas), and financial solutions for implementing the practical issues.

Hydrometeorological RT in the field of disaster prevention gives a forecast / warning for natural disasters.

8) Please provide your name and contact details or name and contact details of appropriate contact person. Please also provide references or websites where more detailed information can be found, if available.

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TEMPLATE FOR SUBMITTING CASE STUDIES ON TRANSBOUNDARY FLOOD ISSUES

Second workshop on Transboundary Flood Risk Management

Geneva, 19-20 March 2015

1) Name of the river basin(s) you are proposing:

Prut River Basin, a tributary of the Danube.

2) Please shortly describe the river basin/sub-basin, basin States, climatic conditions (e.g. climate zone, precipitation amount, flood season, role of snow and ice melt in flood generation)

The Prut River Basin is located on the territories of Romania, Ukraine and the Republic of Moldova.

According to long-term observations of the hydrological regime of the river, it was found that almost every year there are two pronounced peaks in river flow - a spring tide, provoked by the melting of snow in the Carpathian area, and a summer leash, formed as a result of heavy rains in the Carpathians.

3) What types of floods affect the river basin (riverine/fluvial floods, flash floods/pluvial floods, coastal floods, groundwater floods, flooding related to reservoir operation, etc.)? Please provide a short account of the major flood events that have affected the basin in the past decade(s) as well as their impacts (e.g., in terms of losses of live, damages to property and overall economic losses). If possible, please indicate how many of the basin States were affected by each event.

The greatest danger to the Republic of Moldova are sudden rain floods which are provoked by heavy rainfall in the Carpathians. It is often sufficient to have one day of heavy precipitation in the Prut catchment area in the Carpathians for the situation to become threatening in the lower reaches of the river.

Over the past decades, quick floods caused huge material losses, which were heaviest in the years 1969, 1980, 1998, 2006, 2008, 2010, respectively. These floods covered all the three states in which the basin of Prut River was situated: Romania, Ukraine and the Republic of Moldova. The maximum river flow during a flood event was 3,600m³/sec in 2008, with a minimum flow rate of 2,5m³/sec in 1904.

Due to torrential rains in the Carpathian zone in the basins of the Prut and Nistru in 2008 80 settlements were flooded, including 529 residential houses (of which 126 were destroyed), 552 basements, 417 wells, 600 villas, 9 holiday camps, 68 tourist camps, and 2 churches. Flooded ware also 211 gardens, 14 hectares of vineyard, 3,329 hectares with crops, 1,779 hectares private lands. 2,394 families (6,239 people) were evacuated, and from the holiday resorts, 8,000 people were rescued. The general material damage caused by flooding is estimated at 62.5 million dollars.

In June - July 2010, again as a result of the floods on the rivers Prut and Nistru, 2 people were killed, 38 settlements were flooded , including 887 residential houses (of which 325 were completely destroyed) 780 basements, 249 wells, 2 churches, 2 bridges, 2 km of roads, 59 acres of gardens, 8 hectares of vineyards, and 6,027 hectares of crops. 1,013 families (2,659 people) were evacuated. In general, the material damage amounted to about $ 82 million.

4) Please provide information on arrangements that provide a basis for cooperation in terms of flood management in the basin, such as bi- or multilateral agreements and institutions (e.g. river basin organizations).

Between the Republic of Moldova and Romania, an intergovernmental agreement on the management of water resources of the Prut River was signed in 2010. The

agreement created a joint hydrotechnical commission, which operates freely and which makes all decisions on rational water use of the river Prut, as well as organizing the operational management of floods and low water periods. In addition, a joint sub-commission was created to organize the management of the Kosteshty - Stanca hydropower plant.

Between the Republic of Moldova and Ukraine, an agreement on transboundary water management was also signed in 1994. Under this agreement, the authorized institutes of the two governments operate on the implementation of the internal agreement in the fields of:

- Water Resources Management.
- Water - Environmental Monitoring.
- The preservation of biodiversity.

Between Romania and Ukraine, an intergovernmental agreements on transboundary water management is also in operation.

5) Please indicate the scope and mandate of these arrangements in terms of flood management (e.g. flood forecasting and warning, emergency assistance, exchange of basin hydrological data and information, joint studies, coordination of flood defence projects, coordinated flood emergency management, joint basin planning (land and water), joint Integrated Water Resources Management plans).

In particular, for flood forecasting, the information provided by the "Mlodovy Hydrometeorological Service" is used (in Moldova), which, in turn, has an agreement on the exchange of data with the Hydrometeorological Services of Ukraine and Romania.

The sub-commission on the Kosteshty - Stanca hydropower plant is located on the Romanian side, but is equally controlled by the respective office on the Moldovan side which operates the power plant. All decisions on the discharge of water, power generation and other operative decisions are made solely on the basis of mutual consultations.

Currently, the first implementation phase of a three-pronged project called "*The Prevention and Protection against Floods in the Upper Siret and Prut River Basins, through the Implementation of a modern Monitoring System with Automatic Stations - East Avert*" is running and expected to be finalized at the end of September this year (2015). The project is a trilateral cooperation project between of Ukraine, Romania and the Republic of Moldova.

6) Please provide indication on what are the main factors contributing to success of those arrangements for cooperation on transboundary flood management. What are the major shortcomings in flood management cooperation and the underlying technical systems and institutional arrangements that provide support?

The main factors contributing to the success of the agreements in the field of cross-border cooperation in the management of risks associated with flooding is the understanding of the responsibilities of experts on both sides, and of the possible negative consequences as a result of inadequate management.

Regarding shortcomings for a fully harmonious and effective risk management, it is necessary to mention the missing funds for a full-scale reconstruction of the hydroelectric power plant and the dams along the embankment of the river Prut, as well as lack of funds for the implementation of a modern system of prediction of floods, including weather forecast and predictions of storm situations in the Carpathians.

7) Please propose one technical area (such as provided under 4 above) or institutional area (e.g. flood management policy, law, organizational setup, finances, capacity building for specific technical areas) that you see as the key area where the flood management system could be improved in the shared basin. Please be as specific as possible.

In our opinion and that of the main scientists, key for improving flood risk management in the Prut river basin are:

- Construction of a new hydroelectric power plant.
- Maintaining in good technical condition the existing hydraulic components/power plants.
- Ensuring stable monitoring of and real-time information on the formation of floods at the stage of the formation of heavy rains and storms in the upper reaches of the river basin.

Furthermore, a study showed further necessities:

- The monitoring of the embankment dams to ensure they maintain their integrity (like checking for molehills and of other rodents, the timely stubbing of the trees, shrubs, etc.).
- The construction of rainwater structures (in the flood period) on the territory of Romania, Ukraine and the Republic of Moldova in the catchment area above the reservoir Costesti – Stanca.
- Extension of the natural retention zones of the river and reconstruction of wetlands, based on the removal of dilapidated buildings from the flood zones.

- Revision of the operating rules of the reservoir in view of possible climate change.
- The reparation of the hydraulic structures and hydro-mechanical equipment of the dams (antifiltering activities, the restoration of expansion joints, implementation of an information system judging on the groundwater level in the dam´s body while obtaining, processing and transmission of the data to the control station).
- Hydraulic modeling of the floodplain of the Prut River in the area from the reservoir Costesti - Stanca to the confluence with the Danube River.
- Technical analysis of the ridging dams on the Moldovan and Romanian side and of the collector - drainage network and drainage pumping stations in the floodplain
- Synchronization of the maintenance and other works on both sides of the river.
- Reparation and modernization of the dams (also on the tributaries), the drainage pumping stations, the drainage channels and of the power lines and transformer substations.
- The introduction of a hydraulic model for the flood management of the Prut River in combination with the program of formation of flood forecasting in the upper reaches.

8) Please provide your name and contact details or name and contact details of appropriate contact person. Please also provide references or websites where more detailed information can be found, if available.

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TEMPLATE FOR SUBMITTING CASE STUDIES ON TRANSBOUNDARY FLOOD ISSUES

Second workshop on Transboundary Flood Risk Management

Geneva, 19-20 March 2015

1) Name of the river basin(s) you are proposing

Rhine river basin/ International river basin district Rhine (IRBD)

2) Please shortly describe the river basin/sub-basin, basin States, climatic conditions (e.g. climate zone, precipitation amount, flood season, role of snow and ice melt in flood generation)

The Rhine connects the Alps to the North Sea. It is 1.232 km long and one of the most important rivers in Europe. The river catchment area covering some 200,000 km² and spreads over nine states: Italy, Austria, Liechtenstein, Switzerland, France, Germany, Luxemburg, Belgium and Netherlands. Approximatively 58 million inhabitants are living within the Rhine basin. The topography of the Rhine catchment is various and includes different climatic zones (alpine, low mountainous, atlantic, semi-continental climate). Different discharge regimes are overlapping: The southern part near the Alps (Basel) is characterized by the interplay of snow cover constitution and in winter and snow melt comparatively high precipitation in summer ("snow regime" or nival regime). As a consequence, flood events mainly occur in summer. Waters draining the Central Upland region (Neckar, Main, Nahe, Lahn, Moselle, etc; Trier gauging station) are characterised by a "pluvial regime" with prevailing winter floods. Since these two regimes overlap, the downstream discharge distribution over the year ("combined regime", Cologne gauging station) is increasingly uniform. Furthermore, climate change consequences on the discharge lead to more homogenous runoff in the south, while the seasonal distribution becomes more marked in the north. Together with land settlement and man-made water works, this is resulting in diverse flood patterns.

3) What types of floods affect the river basin (riverine/fluvial floods, flash floods/pluvial floods, coastal floods, groundwater floods, flooding related to reservoir operation, etc.)? Please provide a short account of the major flood events that have affected the basin in the past decade(s) as well

as their impacts (e.g., in terms of losses of live, damages to property and overall economic losses). If possible, please indicate how many of the basin States were affected by each event.

The Rhine basin is showing different types of floods:

- The Rhine possesses a complex discharge regime. Extreme floods frequently do not concern the whole Rhine, but the Alpine Rhine, the High Rhine and the Upper Rhine (mostly in summer) or the Middle Rhine and the Lower Rhine (mostly in winter / spring). There are two main types of important extreme flood events according to the hydro-meteorological causes:
    - winter or spring floods which are released by warm air intrusion with snow melt in lowlands and low mountains or by the snow melt in spring in connection with important rainfall. This was the case for two major flood events causing following damages on the Middle, Lower and Delta Rhine:
        - December 1993: 1.4 Billion euro (Cologne: approx. 75 million euro)
        - January/February 1995: 2.6 Billion euro (Cologne: approx. 35 million euro)
    - summer floods caused by heavy or long lasting precipitation events (in connection with late snow melt/run-off resulting from glacier in the Alps).
- In the Alps but also in other parts of the Rhine basin, flash and urban floods can occur as a result of local heavy precipitation and soil sealing.
- On the North Sea coast, coastal floods have occurred in the past (e.g. in 1953) and can happen in the future as a result of heavy sea storms.

An exhaustive list of important past flood events can be found here.

In 2001 a study carried by the ICPR showed that an overall potential damage of approx. 165 Billion euro could result from an extreme flood on the Rhine. New results of flood risk and damage evolution/reduction will be published this year.

4) Please provide information on arrangements that provide a basis for cooperation in terms of flood management in the basin, such as bi- or multilateral agreements and institutions (e.g. river basin organizations).

Under the umbrella of the ICPR 8 states and the EU are closely cooperating in water and flood risk management involving several types of actors on different decision levels. As a result of the two catastrophic flood events from 1993 and 1995 the ICPR has since 1998 implemented the Action Plan on Floods. Since 2007 it has established a framework for the exchange of information and coordinated implementation of the Flood Directives (FD) **within the international river basin district Rhine** (IRBD).

The coordinated implementation of the FD in the Rhine river basin brings into play following stakeholders:

- The ICPR member and partner countries (FR, DE, LUX, NL, CH, AT, FL, BE-Wallonia plus the EU) through national delegations (working, expert and strategic groups).
- Different observers and further partners as intergovernmental organizations, non-governmental organizations (e.g. related to flood prevention, nature protection …).
- Besides, the public is being informed (or consulted) by various means (brochures, website www.iksr.org).

According to the FD different common products (reports, maps) have been worked out and published, amongst them, by End of December 2014 the first draft of a single Flood risk management plan (FRMP) for the Rhine basin. The final FRMP will be finalized and available in

English by December 22th 2015. Furthermore the ICPR is publishing begin of 2015 the first climate change adaptation strategy for the Rhine basin based on solid climate change effects studies.

5) Please indicate the scope and mandate of these arrangements in terms of flood management (e.g. flood forecasting and warning, emergency assistance, exchange of basin hydrological data and information, joint studies, coordination of flood defence projects, coordinated flood emergency management, joint basin planning (land and water), joint Integrated Water Resources Management plans).

Work under the ICPR has resulted in 3 different types of FD outcomes:

1st step of the FD "preliminary flood risk assessment": An overview map including a short report has been published on the website of the ICPR, describing the exchange of information and coordination required by the FD for transboundary basins.

2d step of the FD "drafting of flood hazard and risk maps: the ICPR has published by End of 2013 a specific report with an overview map and update the ICPR Rhine Atlas 2001 according to new national flood hazard and risk maps. The new (digital) Rhine Atlas which will be published by March 2015 consist of a common flood hazard map and flood risk map of the main stream from the Alpes down to the North Sea automatically linked to more accurate maps available on national, regional or tributary levels.

3rd step of the FD "drafting of the flood risk management plan: the ICPR started in 2010 to draft the 1st FRMP for the IRBD Rhine, based among others on the state of implementation of the APF by 2010 (see summary in the brochure "The Rhine and its catchment: an overview"). 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. One of the main measures with transboundary effects of the new FRMP is the creation of retention basins, relocating dikes and enlarging the river bed as well as giving more room for the river.

In the 15th conference of the Rhine Minister (Basel, October 2013), it was stated that since 2010, downstream of Basel (on the Upper and Lower Rhine) retention areas are available for up to 229 million m^3 of water. Furthermore, 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.

6) Please provide indication on what are the main factors contributing to success of those arrangements for cooperation on transboundary flood management. What are the major shortcomings in flood management cooperation and the underlying technical systems and institutional arrangements that provide support?

Successes:

- The ICPR has a good work organization and decisions-taking process with dedicated working and expert groups. ICPR is a decentralized international organization with representatives in the whole Rhine basin has proved to be efficient.
- Developed formal/informal contacts between delegates/representatives of the states.
- With the WFD and the FD the scope on the “basin” has increased (before mainly on the main stream of the Rhine) and it brought new cooperation partner countries from the basin (Austria, Liechtenstein, Wallonia).
- Improved basin-wide exchange of information, improvement of risk knowledge for decision-makers (new data, data coordination/harmonization, similar methodologies/data).
- Emphasis on the whole cycle of flood risk management and with the FD inclusion of “new” risk assets (environment, cultural heritage).
- Intensified and improved cooperation with NGO’s.
- As the FD is a European law, it has to be transposed and implemented by the EU Member States, so it is more powerful than formal ICPR recommendations.
- More bottom-up approaches, public consultation/participation (this will initiate higher acceptance for the implementation of measures).

Barriers:

- The FD is rather broad and this results sometimes in different national understandings and approaches of the directive.
- The FD is a new directive, so the ICPR lacked sometimes of experience. This could result in formal/administrative discussion/decisions rather than discussion in substance but also on extra work/time cost to align the APF with FD
- Difficulties to align the national FRMP and the international FRMP, also because of the superposition of the periods prescribed for drafting the plans.
- Short timing of the FRMP cycles (6 years, parallel to the WFD), but measure implementation (e.g. retention basin creation) needs more time than one FD cycle, often more than 10 years
- “Pressure” of sanction by the EU-COM can be a potential brake to find innovative solutions or measures
- Still problems with the alignment of ecology and flood protection, strengthening the win-win-possibilities, convincing processes are lacking
- Some financial or administrational lacks or lack of upstream-downstream solidarity can disturb the implementation of measures on a local level.

7) Please propose one technical area (such as provided under 4 above) or institutional area (e.g. flood management policy, law, organizational setup, finances, capacity building for specific technical areas) that you see as the key area where the flood management system could be improved in the shared basin. Please be as specific as possible.

We would propose the implementation of the new Flood risk management plan and the compliance of national and international strategies/measures. Emphasis on one specific type of measure from the FRMP, such as the planning and building of retention basins, could be also made.

8) Please provide your name and contact details or name and contact details of appropriate contact person. Please also provide references or websites where more detailed information can be found, if available.

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TEMPLATE FOR SUBMITTING CASE STUDIES ON TRANSBOUNDARY FLOOD ISSUES

Second workshop on Transboundary Flood Risk Management

Geneva, 19-20 March 2015

1) Name of the river basin(s) you are proposing:

The Tisza River basin.

2) Please shortly describe the river basin/sub-basin, basin States, climatic conditions (e.g. climate zone, precipitation amount, flood season, role of snow and ice melt in flood generation)

The Tisza river is the largest tributary of the Danube area. The basin area is 157,186 km2, with a length of 967 km, flowing through four countries: Romania - 51%, Ukraine - 25.6%, Hungary - 10%, and Slovakia - 13.4%. Total water resources of the basin of the Tisza in Ukraine is 13.3 km3 in an average water year.

The total length of the river Tisza in Ukraine - 262 km. In Ukraine, the Tisza basin is located entirely within a single region - Transcarpathian. All the rivers in Transcarpathia directly flow into the Tisza, or its tributaries. The area of the Transcarpathian region and accordingly the Tisza catchment area within Ukraine is about 12.8 thousand. Km2.

The climate of Transcarpathia is moderately continental. The climate is influenced by solar radiation, land surface and atmospheric general circulation.

Long-term average rainfall ranges from 870 mm (foothills) to 1600 mm (midlands). On the windward slopes, rainfall can reach 1100-1200 mm per year. Intra-distribution of precipitation in Transcarpathia has two peaks - in July and December.

A distinctive feature of intra-flow distribution in the basin of the Upper Tisza is to reduce the height of the winter runoff. A significant part of solid precipitation moves in the spring or summer seasons. This explains the more intensive runoff in the summer-autumn season. Most of the spring runoff is in April (18%) and May (17%), and in general the spring accounts for 40% of annual runoff. The summer season accounts for 24% of the flow, with the largest flow observed in June (11%). Winter is a season, which accounts for the smallest share of the annual flow - 15%.

The Tisza has the highest level rise and flow characteristic during the autumn and winter floods. The share of these floods is an average of 20-30% of the flood, emerging within a year. Intra-flow regime of the rivers of the basin is characterized by the passage of floods in the period from March to August. In dry years, high floods occasionally occur in the fall and even winter. In light of this complexity the flow regime of the rivers delimitation seasons rather arbitrary, since floods occur throughout the year.

3) What types of floods affect the river basin (riverine/fluvial floods, flash floods/pluvial floods, coastal floods, groundwater floods, flooding related to reservoir operation, etc.)? Please provide a short account of the major flood events that have affected the basin in the past decade(s) as well as their impacts (e.g., in terms of losses of live, damages to property and overall economic losses). If possible, please indicate how many of the basin States were affected by each event.

The territory of Transcarpathia refers to one of the most flood prone regions in Europe, the frequency of floods on its rivers on average 3-8 times per year. They differ in capacity and coverage of large areas. Significant deviations highlands cause transient development of flood levels to reach 1.5-2.5 m in 3-4 hours. Floods in the river basin Yew can be formed in any season, as a result of heavy rains, melting snow or a combination of these two factors.

Melting snow without rain is rare in the Tisza basin and floods of this type do not exceed 10-12% of the total. Increasing the temperature is almost always accompanied by rain. Thus, large flood waves generated more late winter and early spring.

Over the past decade in the Carpathian region on the Upper Tisza significant floods occurred in 1980, 1992, 1993, 1995, 1997, 1998, 2001, 2008 and 2010. Especially catastrophic floods were in November 1998 and March 2001.

Sum of the damage from the flood in 1998 amounted to almost 810 million Hryvnia. At the same time, floods damaged 40.4 km water control dams, 8.93 km of shore facilities, 17 km of canals; flooded 407,093 homes, damaged - 2877, destroyed 2,695 buildings; incapacitated 28 sewage pumping stations, destroyed and damaged 48 bridges destroyed and damaged 48.6 km 722.2 km of roads. In the 9 regions of Transcarpathia found 457 landslides, mudflows 87, 135 km lateral erosion.

Flood damage in was 2008 169 million Hryvnia, and in 2010 about 73 million Hryvnia.

4) Please provide information on arrangements that provide a basis for cooperation in terms of flood management in the basin, such as bi- or multilateral agreements and institutions (e.g. river basin organizations).

The framework for international cooperation in the management of flood risks in the Tisza basin are bilateral intergovernmental agreements on water management on boundary waters between Ukraine and Hungary (28.07.1993), the Slovak Republic (14.06.1994) and Romania (30.11.1997). They regulate the work in the following areas:

- Flood protection of the population and border areas,
- Conducting hydrological and meteorological observations,

- Border waters monitoring and assessment of water quality.

Agreements take into account the provisions of the "Convention on the Protection and Use of Transboundary Watercourses and International Lakes" (Helsinki, 16 March 1992) and the "Convention for the Protection of cooperation and balanced water of the Danube River" (Sofia, 29 June 1994). These documents specifically defined obligations of the parties in terms of frequency and exchange of information, individual and collective action in emergency situations related to water. Also BUVR Tisza takes part in the International Commission for the Protection of the Danube River.

5) Please indicate the scope and mandate of these arrangements in terms of flood management (e.g. flood forecasting and warning, emergency assistance, exchange of basin hydrological data and information, joint studies, coordination of flood defence projects, coordinated flood emergency management, joint basin planning (land and water), joint Integrated Water Resources Management plans).

According to the Intergovernmental Agreement the Parties drafted and approved regulations and orders that govern the working groups on flood protection, water quality and hydrometeorology. Orders regulate measures and activities of water management organizations prior to the flood, during the flood and after the flood of waters, as well as drainage channels that cross state borders in order to achieve consistency and maximum efficiency in the work of the Parties, with the least losses for the national economy.

Given these factors, water management organizations Parties regularly exchange and coordinate project documentation for restoration of damaged flood water bodies, reconstruction of existing and construction of new facilities in the border strip.

An important area of cooperation on border waters is the creation of an effective system for forecasting and monitoring the flood situation in the basin. A decade ago, the state of the hydrological warning service could not provide advance warning of passing parameters and flood sufficient to take the necessary protective measures because of the limited data from areas of intense runoff formation in the upland areas, imperfect technology monitoring, data collection, transmission and processing hydrometeorological information.

It is therefore extremely important area of cooperation between Ukraine and Hungary, water managers is to develop general information and measuring system TISA for flood forecasting and management of water resources in the basin. The creation of this system is aimed at implementing the program of flood protection, expansion of zones of observation, collection and processing of information from areas of intensive formation of flood flow, preventing their formation and transmission, and take adequate measures to protect the area from possible flooding.

In connection with the results of studies in recent years with the most modern hydrological and hydraulic models, experts and scientists predict the future a further increase in flood levels on the upper parts of the river Tisza. Given the high degree of flood risk areas and considerable intensity of floods in the region, as well as to improve integrated planning of hydraulic engineering and flood control measures at the regional level, today water management organizations of Ukraine and Hungary developed a general Flood development program for the Upper Tisza Basin.

This program includes the development of activities that are of particular importance to ensure reliable flood safety of the population and territories of public interest not only in Ukraine and Hungary, but also other neighbouring countries Tisza River Basin - Slovakia and Romania. The program includes 22 objects that include the reconstruction of dams, construction of mountain and lowland flood control reservoirs, landscaping beds channels and further improving the overall system for forecasting and monitoring floods AIMS - "Tisza". Implementation of this program can ensure the security of the border areas in the coming decades.

6) Please provide indication on what are the main factors contributing to success of those arrangements for cooperation on transboundary flood management. What are the major shortcomings in flood management cooperation and the underlying technical systems and institutional arrangements that provide support?

The main factors contributing to the success of such agreements:

- Exchange of experience,
- Definition of the general long-term priorities,
- Science and innovation,
- Phased development,
- Strengthening the role of regional organizations,
- Search for a mutually acceptable balance of interests and finding agreement,
- Preparation of the necessary technical resources, careful and detailed design engineering and design documents, as well as mechanisms for their implementation.

The main disadvantages:

- Differences regarding the legal, financial and technical conditions of the Parties.

7) Please propose one technical area (such as provided under 4 above) or institutional area (e.g. flood management policy, law, organizational setup, finances, capacity building for specific technical areas) that you see as the key area where the flood management system could be improved in the shared basin. Please be as specific as possible.

The development of national policies for integrated flood risk management, the subsequent negotiation of its results, as well as preparation of maps of risks associated with floods in the Tisza River Basin Transboundary.

8) Please provide your name and contact details or name and contact details of appropriate contact person. Please also provide references or websites where more detailed information can be found, if available.

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