ADAPTATION FUND

PRE-CONCEPT FOR A REGIONAL PROJECT/PROGRAMME

PART I: PROJECT/PROGRAMME INFORMATION

Title of Project/Programme	**Integrated climate-resilient transboundary flood risk management in the Drin River basin in the Western Balkans**
Countries:	Albania, the Former Yugoslav Republic of Macedonia, Montenegro
Thematic Focal Area[1]:	Disaster risk reduction and early warning systems
Type of Implementing Entity:	Multilateral Implementing Entity (MIE)
Implementing Entity:	UNDP
Executing Entities:	UNDP, Global Water Partnership
Amount of Financing Requested:	US$9,927,750 (in U.S Dollars Equivalent)
Project Duration:	5 years / 60 months

Project / Programme Background and Context:

The Drin River Basin (DRB) is a transboundary river basin, which is home to 1.6 Million people and extends across Albania (30% of basin area, 27% of total country area, 37% of basin population), Kosovo[2] (23% of basin area, 42% of total country area, and 35% of basin population), the Former Yugoslav Republic of the Former Yugoslav Republic of Macedonia (17% of basin area, 13% of total country area, and 11% of basin population), Montenegro (22% of basin area, 32% of total country area, and 17% of basin population) and Greece. The DRB countries and entities (Riparians) are increasingly exposed to the impacts of climate change. Climate change and climate variability have been increasing the frequency, intensity and impact of flooding in the basin.[3] See Part II and Annex 2 for the outline of the climate change risks and vulnerability in the sub-region.

The impacts of the climate-induced flooding are exacerbated by the anthropogenic pressures including rapid urbanization; deforestation; poor solid waste management; unsustainable use of land and water resources; intensive agriculture, forestry and mining activities; unsustainable tourism. These non-climate factors are being analyzed and addressed in the sub-region through a regional GEF supported project “Enabling Transboundary Cooperation and Integrated Water Resources Management in the Extended Drin River Basin” (GEF Drin Project) implemented by UNDP that supports the implementation of the Drin MoU for the coordinated management of the Drin Basin. However, the GEF-supported project and the on-going baseline sub-regional initiatives cannot comprehensively address climate change adaptation needs of the riparian countries and establish a comprehensive basin level climate risk and flood risk management, which needs to include: (1) exchange of risk knowledge and climate information; (2) basin level climate change adaptation and flood risk management strategy and plans; (3) combination of structural and non-structural interventions; (4) institutional capacity. The lack of comprehensive basin-level climate risk and flood risk management is increasing the vulnerability of the basin population to flooding. An effective climate risk and flood risk management in the DRB calls for a coordinated transboundary climate information management and action across the sub-region.

Project / Programme Objectives:

The objective of the project is to assist the riparian countries in the implementation of an integrated climate-resilient river basin flood risk management approach in order to improve their existing capacity to manage flood risk at regional, national and local levels and to enhance resilience of vulnerable communities in the DRB to climate-induced floods. The countries will benefit from a basin-wide transboundary flood risk management (FRM) framework based on: improved climate risk knowledge and information; improved transboundary cooperation arrangements and policy framework for FRM and; concrete FRM interventions. As a result, the Adaptation Fund project will improve the resilience of 1.6 million people living in the DRB (direct and indirect beneficiaries).

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[1] Thematic areas are: Food security; Disaster risk reduction and early warning systems; Transboundary water management; Innovation in adaptation finance.

[2] References to Kosovo shall be understood to be in the context of Security Council Resolution 1244 (1999)

[3] FLOOD PREVENTION AND MANAGEMENT: Gap analysis and needs assessment in the context of implementing the EU Floods Directive, September 2015, European Commission

The project will include implementation of an end-to-end ***fully-integrated flood forecasting and early warning system*** (FFEWS). In this regard, the project will supplement existing basin hydrological and hydraulic forecasting models, establish warning thresholds, produce impact-based forecasting and dissemination of warnings within a common platform. The project will develop and implement ***transboundary integrated FRM strategies*** providing the national authorities with robust and innovative solutions for FRM, DRR and climate adaptation, including ecosystem-based gender sensitive participatory approaches. In addition, the project will develop the underlying ***capacity of national and regional institutions*** to ensure sustainability and to scale up the results. It will support stakeholders by providing guidance, sharing climate information, knowledge and best practices. The project will also invest in the ***priority structural and community-based non-structural measures***. Importantly, the project is aligned with and will support the implementation of the EU Floods Directive (EUFD) in DRB countries.

The AF project will build upon experience of prototypes projects[4,5] in the region and will include the following ***innovations***:1) introduction of international best practice in flood hazard and risk assessment, modelling and mapping in line with EUFD; 2) comprehensive FFEWS introducing state of the art forecasting technology and addressing institutional arrangements, communications and response; 3) innovative mix of structural and non-structural interventions based on climate risk-informed design; 4) agro-forestry measures and community-based flood resilience schemes. The ***socio-economic benefits*** include reduced damages and losses and improved food production (through protection of agricultural land). This will have direct and indirect livelihood protection and potentially income generation benefits. ***Environmental benefits*** include improved ecosystem functions through better spatial planning and agro-forestry.

Project / Programme Components and Financing:

Project/Programme Components	Expected Outcomes	Expected Outputs	Countries	Amount (US$)
1. Component 1 Hazard and Risk Knowledge Management Tools	Improved climate and risk informed decision-making, availability and use of climate risk information	Output 1.1. Strengthened hydrometric monitoring networks in all riparian countries based on a unified optimized basin-scale assessment of monitoring needs	Albania, the former Yugoslav Republic of Macedonia, Montenegro	2,150,000
		Output 1.2. Improved knowledge of CC-induced flood risk and risk knowledge sharing through the introduction of modelling tools and technologies for strategic flood risk assessment based on EUFD and development of basin flood hazard maps		
		Output 1.3. GIS-based vulnerability, loss and damages assessment tools and database established to record, analyse and predict flood events and associated losses		
2. Component 2 Transboundary institutional, legislative and policy framework for FRM	Improved institutional arrangements, legislative and policy framework for climate-resilient FRM, and development of CCA and FRM strategy and plans at the basin, sub-basin, national and sub-national levels	Output 2.1. Drin River Basin FRM Policy Framework and improved long term cooperation on FRM	Albania, the former Yugoslav Republic of Macedonia, Montenegro	950,000
		Output 2.2. Regional, national and sub-national institutions (including meteorological and hydrological sectors) are trained in climate-resilient FRM, responsibilities clarified and coordination strengthened		
		Output 2.3. Drin River basin Integrated CCA and FRM Strategy and Plan developed		
3. Component 3 Community-based climate change adaptation and FRM interventions	Strengthened community resilience through improved flood forecasting and early warning, implementation of structural and non-structural measures and enhanced local capacity for CCA and FRM	Output 3.1. Improved flood forecasting and early warning at the transboundary level through the establishment of a DRB FFEWS	Albania, the former Yugoslav Republic of Macedonia, Montenegro	5,400,000
		Output 3.2. Design and construction of structural risk reduction measures in prioritized areas using climate risk information and cost-benefit appraisal methods		
		Output 3.3. Strengthened community resilience to flooding through the participatory design and implementation of non-structural community-based resilience, adaptation and awareness measures		
6. Project/Programme Execution cost				650,000
7. Total Project/Programme Cost				9,150,000
8. Project/Programme Cycle Management Fee charged by the Implementing Entity (if applicable)				777,750
Amount of Financing Requested				9,927,750

[4] AF-funded, UNDP Implemented project, "Developing climate resilient flood and flash flood management practices to protect vulnerable communities of Georgia"
[5] GEF-funded, UNDP Implemented project, "Technology transfer for climate resilient flood management in Vrbas River Basin" in BiH

PART II: PROJECT / PROGRAMME JUSTIFICATION

Geographical Context: The Drin River runs through mountainous areas in the south-western Balkans towards the Adriatic Sea, providing the third greatest river discharge into the European Mediterranean. The total catchment area of the basin is around 19,686 km^2 and includes Black Drin which drains from Lake Ohrid, flows up north to meet White Drin and flow together as Drin until they meet the Buna/Bojana River and discharge finally to Adriatic Sea (Fig. 1, Annex 1). The basin includes three transboundary lakes - the Skadar/Shkodra, Ohrid and Prespa Lakes - the globally important biodiversity areas. The Drin Delta is a complex of relatively intact coastal lakes, marshes and forests recognized as an Important Bird Area. The main sectors relying on DRB waters are agriculture, energy, water supply and sanitation, mining and industry, environment, fisheries, and tourism[6].

Climate change context and flood risk in the Drin Riparian countries: Climate change is already having an impact and is likely to intensify in the future. Historical flood data from the Western Balkans suggests a more frequent occurrence of flood events, characterized by more extreme and more rapid increase in water levels attributed to an uneven distribution of precipitation and torrential rain. Larger areas and greater population numbers are being affected by flooding. According to the NCs to UNFCCC of the beneficiary countries, as well as to the report 'The state of water in Kosovo', climate change will have further serious negative impacts in the DRB including increased frequency and intensity of floods and droughts, increased water scarcity, intensified erosion and sedimentation, intensified snow melt and sea level rise. The average annual temperature is projected to increase by 2-3°C by 2050 and precipitation will decrease in summer, resulting in longer dry periods followed by more sudden heavy rainfalls. This combination increases the likelihood of floods as well as their destructive nature. CC impacts on water resources will have cascading effects on human health, economy, society and the environment. An outlook of climate and flood risks in DRB countries is presented in Annex 2.

Legislative and institutional framework for water management in Drin Riparian countries: A recent review[7] of the institutional and legal framework for water management in the DRB found that national legislation is not fully aligned with the EU Acquis; there is high fragmentation of competencies, overlapping/conflicting responsibilities of institutions; no basin management plans addressing climate risks; limited monitoring; non-reliable, non-harmonized and limited sharing of data among institutions within and between countries; no basin water cadastre; water management investment was not supported by robust analysis, no investment plans and no comprehensive financial risk transfer mechanisms. The report recommends: (i) alignment of the national legislation with the EU Acquis, especially EUFD; (ii) clear assignment of responsibilities among institutions; (iii) strengthened mandates of local government; (iv) drafting and implementing river basin management plans (RBMPs) and flood management plans based on flood risk maps; and (v) cooperation among DRB countries on FRM.

Cooperation over water resources management in the Drin Basin: Drin Coordinated Action was established through a Shared Vision for the sustainable management of the Basin and the related MoU (Tirana, 2011) signed by the Ministers of the water and environment of the Drin Riparians: Albania, the Former Yugoslav Republic of Macedonia, Greece, Kosovo and Montenegro. The main objective of the Drin MoU is to promote joint action for the coordinated integrated management of the shared water resources in the basin. The Drin MoU provides political framework for cooperation among the riparians and identifies short-, medium- and long-term actions to address problems affecting sustainable development in the DRB. Integrated DRB Management Plan is the long-term objective. The following institutional set up supports the Drin Coordinated Action (Annex 1, fig. 3): (i) The Meeting of the Parties; (ii) The Drin Core Group (DCG) coordinates implementation of the MoU; (iii) Expert Working Groups (EWGs), an EWG on Floods is being established; (iv) DCG Secretariat hosted by the Global Water Partnership–Mediterranean (GWP-Med). The UNDP/GEF Drin Project[8] executed by GWP-Med assists in building consensus among countries on key transboundary concerns and drivers of change, including climate variability and change, and in reaching an agreement on priority actions.

Flood forecasting and early warning in the Drin Basin: The GIZ-funded project "*Climate change adaptation in the Western Balkans*"[9] (2012-2018) has been providing advisory services and support to Albania, Kosovo, the Former Yugoslav Republic of Macedonia and Montenegro for enhanced flood and drought risk management in DRB focusing on five key areas: (i) establishing a regional flood EWS; (ii) drafting CC adaptation strategies; (iii) local flood and drought management plans; (iv) transboundary water resource management concepts; (v) integrating CCA into urban planning for Tirana, Podgorica and Belgrade. In Albania and Montenegro FRM plans have been drawn for 31 municipalities and local implementation capacities were enhanced. The rain and stream

[6] Trans-Boundary Waters and Integrated Water Resource Management in the Western Balkans Region, 2007

[7] Flood Prevention and Management – Gap analyses and needs assessment in the context of implementing the EU Floods Directive", September 2015, funded by the Wester Balkans Facillity Infrastructure Project, Technical Assistance 4 (IPF 4)

[8] "Enabling transboundary cooperation and integrated water resources management in the extended Drin River Basin" approved by the GEF in 2014. The GEF Drin project includes five components: (1) Consolidating a common knowledge base; (2) Building the foundation for multi-country cooperation; (3) Institutional strengthening for Integrated River Basin Management (IRBM); (4) Demonstration of technologies and practices for IWRM and ecosystem management; (5) Stakeholder Involvement, Gender Mainstreaming and Communication Strategies.

[9] https://giz.de/en/worldwide/29000.html

gauging networks have been extended for flood forecasting with 33 water level and rainfall stations rehabilitated and upgraded. A DRB hydrological model has been developed.

Hence, through donor and government funded projects there has been gradual modernization of the hydrometric network in the DRB (Fig. 2, Annex 1). Under an MoU between the national hydrometeorological institutions there is cooperation and data exchange for flood warning. Warnings are currently based on regional forecasts, European Flood Awareness System (EFAS) and Flash Flood Guidance (SEE FFG). But, as yet, ***no fully-integrated basin wide flood forecasting and early warning system (FFEWS)*** has been developed to provide the maximum lead warning time. Furthermore, no comprehensive basin-wide water level forecasting is available, nor are likely impacts at the local/community level. A further essential development will be the design and implementation of a fully-integrated FFEWS for the basin, which integrates regional, national and community-based systems and provides last-mile flood forecasts, based on EUFD standards and in line with WMO standards.

Description of Proposed Project outputs (See Annex 3 for more details)

Outcome 1: Improved climate and risk informed decision-making, availability and use of climate information

Output 1.1. Strengthened hydrometric monitoring networks in all riparian countries based on a unified optimized basin-scale assessment of monitoring needs. Based on a review of existing monitoring networks in DRB, the optimized network required for basin-scale flood risk monitoring and management will be identified. The hydrometric network design[10] document will be prepared covering network design, prioritized station list, condition of those stations, equipment options, rehabilitation/new installation plan, institutional assessment, O&M plan and preliminary costing. The project will design and implement new/rehabilitated monitoring network. An institutional capacity development plan will be developed and training of hydrometric specialists will be undertaken. The project will establish a unified basin-scale hydrometric database and data sharing protocols. To ensure sustainability of the network, the project will develop financing mechanisms for the network maintenance.

Output 1.2. Improved knowledge of climate-induced flood risk and risk knowledge sharing through the introduction of modelling tools for strategic flood risk assessment based on EUFD and development of basin flood hazard maps. The project will assess current level of EUFD implementation in each riparian country, review data availability for the strategic basin-wide flood hazard and risk modelling and mapping, and commission essential datasets and surveys. Detailed topographic surveys of the river channel through high risk areas will be carried out, including major infrastructure across the river (e.g. bridges, dams, etc.) and along river banks (e.g. flood walls, levees, etc.). A unified approach to flood hazard modelling based on EUFD will be implemented. The project will establish and/or amend existing numerical hydrological and hydraulic models of the basin and produce high resolution inundation maps in line with the EUFD suitable for use in land use planning, development zoning, flood protection design, setting flood insurance criteria, raising public awareness and emergency planning. Climate information sharing platforms, protocols and dissemination mechanisms will be strengthened.

Output 1.3. GIS-based vulnerability, loss and damages assessment tool and database established to record, analyze, predict and assess flood events and associated losses. Methods, tools and protocols will be established and implemented for the strategic collection of socio-economic data and systematic updating of socio-economic flood receptor information (property, land use, economic data, socio-economics information etc.) and community-based risk mapping. The project will develop and implement a GIS-based basin-wide socio-economic risk model which integrates various spatial socio-economic data with the flood hazard maps, performs vulnerability assessment, and produces high-resolution vulnerability maps for the whole basin which will include damages, losses, and loss of life estimates for floods of different return period. The model will enable impact-based flood forecasting, cost-benefit analysis and appraisal of various FRM interventions.

Outcome 2: Improved institutional, legislative and policy framework for FRM, and development of climate change adaptation and FRM strategy and plans at the basin, sub-basin, national and sub-national levels

Output 2.1. Drin River Basin FRM Policy Framework and improved long-term cooperation on FRM. The project will review existing FRM policy and enabling environments in each DRB country and develop basin FRM policies in line with relevant EU directives. A key policy to be implemented will be basin wide floodplain zoning/development policy based on detailed hazard and risk maps. In addition, the project will explore and recommend a basin-wide policy for risk transfer mechanisms such as flood insurance (to be explored during the project development). The project will establish harmonized sectoral FRM policies for priority sectors.

Output 2.2. Regional, national and, sub-national institutions are trained in FRM, roles and responsibilities clarified and coordination mechanisms strengthened for effective climate-resilient FRM. The project will develop a DRB stakeholder and governance analysis focusing on flood management based on the analysis completed by the GEF Drin Project. Based on the analysis, the effectiveness of institutional arrangements in

[10] River water level and flow stations, meteorological station, associated telecommunications equipment.

individual riparian countries towards basin-scale FRM will be analyzed. In consultation with DRB countries and the DCG a strategy and a five-year work program of the Drin EWG on Floods will be developed and implemented.

Output 2.3. Drin River Basin Integrated CCA and FRM Strategy and Plan Developed. The Drin River basin FRM strategy (FRMS) and plan (FRMP) will be developed for the long-term management of flood risk in the basin. The strategy will establish the high-level basin-wide policies for the long-term climate resilient management of flood risk and will be based on detailed strategic climate and flood risk assessment. Basin-level and national FRMPs will outline the detailed actions that will be taken to address flood risk at the basin scale and within each country. It will include a combination of structural and non-structural approaches which will best address flood risk at the basin scale, and will involve developing an inclusive list of potential FRM options.

Outcome 3: Strengthened community resilience through improved flood forecasting and early warning, implementation of structural and non-structural measures and the enhanced local capacity for CCA and FRM

Output 3.1. Improved flood forecasting and EWS at the transboundary level to reduce climate-induced disaster risks in vulnerable communities through the establishment of a Drin basin FFEWS. The work will be based on the enhanced hydro-meteorological monitoring network and risk knowledge delivered under Outcome 1. The project will review existing flood forecasting programmes or elements of FFEWS in DRB[11], assess current institutional arrangements and capacity for basin-scale flood forecasting and response and develop an institutional arrangement for FFEWS. Telecommunications studies will be carried out to determine the requirements of the monitoring and telemetry system as well as warning dissemination system. Flood forecasting models will be developed and implemented for a fully integrated FFEWS to include centralised and community-based EWSs. Training for national and sub-national practitioners and for community EWS operators will be undertaken. Awareness and training workshops for community, NGOs, government and media will be conducted.

Output 3.2. Development, design and construction of structural flood risk reduction measures in prioritized areas using climate risk information, and cost-benefit appraisal methods. The project will undertake feasibility study, design and implementation of structural options such as the provision of flood storage, embankments and walls, local land raising to elevate development areas above the extreme flood level, local improvements to channel capacity and stability, channel diversions, flow control structures, enhanced maintenance and improvements to channels. A long list of options will be examined in terms of the socio-economic, environmental, engineering and hydrological impacts. An appraisal of the short-listed options will be carried out to determine technical performance in terms of mitigation of damages and economic efficiency (CBA). The activity will meet relevant national technical standards and comply with the AF Environmental and Social Policy.

Output 3.3. Strengthened local community resilience to flooding through the participatory design and implementation of non-structural community-based resilience, adaptation and awareness measures. To ensure participatory and sustainable community resilience, the project will provide training and assistance to selected communities on non-structural risk reduction measures. Non-structural options will include ecosystem-based FRM measures for management of hillslope and floodplain vegetation to enable greater rainfall infiltration and reduce erosion. This may include reforestation and the use of seasonal cropping, agroforestry, the use of vegetative bundles to build defences, etc.. FRM measures will promote re-establishment of natural floodplain functionality. The schemes will be subjected to the same appraisal as described in Output 3.2. Community-based adaptation capacities will be built using participatory risk assessment and resilience planning, training and awareness raising. Gender mainstreaming will be ensured. The project will develop local response capacity, train first and second emergency responders and provide training in the operation of the community-based EWSs.

The Adaptation Fund resources will be used to support climate change adaptation and FRM activities in the three eligible DRB countries. UNDP will undertake additional efforts to mobilize co-financing for complementary activities in the territory of Kosovo in order to secure an integrated basin-wide approach to climate change adaptation and FRM and to make sure that none of the DRB communities are excluded from the adaptation action.

PART III: IMPLEMENTATION ARRANGEMENTS

The project will be implemented by UNDP through the Direct Implementation Modality and executed in cooperation with the GWP-Med. UNDP, as Implementing and Executing Entity, will provide technical assistance and oversight. National activities will be implemented through the UNDP Country Offices in DRB countries. The GWP-Med will be engaged for the implementation of regional activities. UNDP and GWP-Med will ensure coordination with the design and implementation of the DRB TDA/SAP under the GEF Drin project. At the regional level the Drin Core Group (DCG) will be the Steering Committee of the project ensuring coordination with the DRB stakeholders. The DCG will also support data sharing and dissemination to the national structures. At the national level, UNDP Country Offices will liaise with National Hydromet Services (NHMS) and other national and local institutions in charge of FRM. The NMHSs and other national FRM entities will be focal points for the technical activities.

[11] The project formulation will examine existing activities, particularly being undertaken by GIZ to avoid duplication of effort, and ensure synergy.

PART IV: ENDORSEMENT BY GOVERNMENTS AND CERTIFICATION BY THE IMPLEMENTING ENTITY

A. Record of endorsement on behalf of the government[12] *Provide the name and position of the government official and indicate date of endorsement for each country participating in the proposed project/programme. Add more lines as necessary. The endorsement letters should be attached as annexes to the project/programme proposal.*

Albania	Date*: (Month, day, year)*
The former Yugoslav Republic of Macedonia	Date*: (Month, day, year)*
Pavle Radulovic, Minister of Sustainable Development and Tourism of Montenegro	Date*: 16 January 2018*

B. Implementing Entity certification *Provide the name and signature of the Implementing Entity Coordinator and the date of signature. Provide also the project/programme contact person's name, telephone number and email address*

I certify that this proposal has been prepared in accordance with guidelines provided by the Adaptation Fund Board, and prevailing National Development and Adaptation Plans (including National Communications to the UNFCCC, national adaptation strategies, disaster risk reduction strategies and action plans etc.) and subject to the approval by the Adaptation Fund Board, commit to implementing the project/programme in compliance with the Environmental and Social Policy of the Adaptation Fund and on the understanding that the Implementing Entity will be fully (legally and financially) responsible for the implementation of this project/programme.	
 *Adriana Dinu* Executive Coordinator UNDP - Global Environmental Finance	
Date: 13 Jan 2018	Tel. and email:adriana.dinu@undp.org +1 (212) 906 5143
Project Contact Person: Natalia Olofinskaya, Regional Technical Advisor, UNDP IRH	
Tel. and Email: nataly.olofinskaya@undp.org; +90 (543) 532-3046	

Each Party shall designate and communicate to the secretariat the authority that will endorse on behalf of the national government the projects and programmes proposed by the implementing entities.

Annex 1

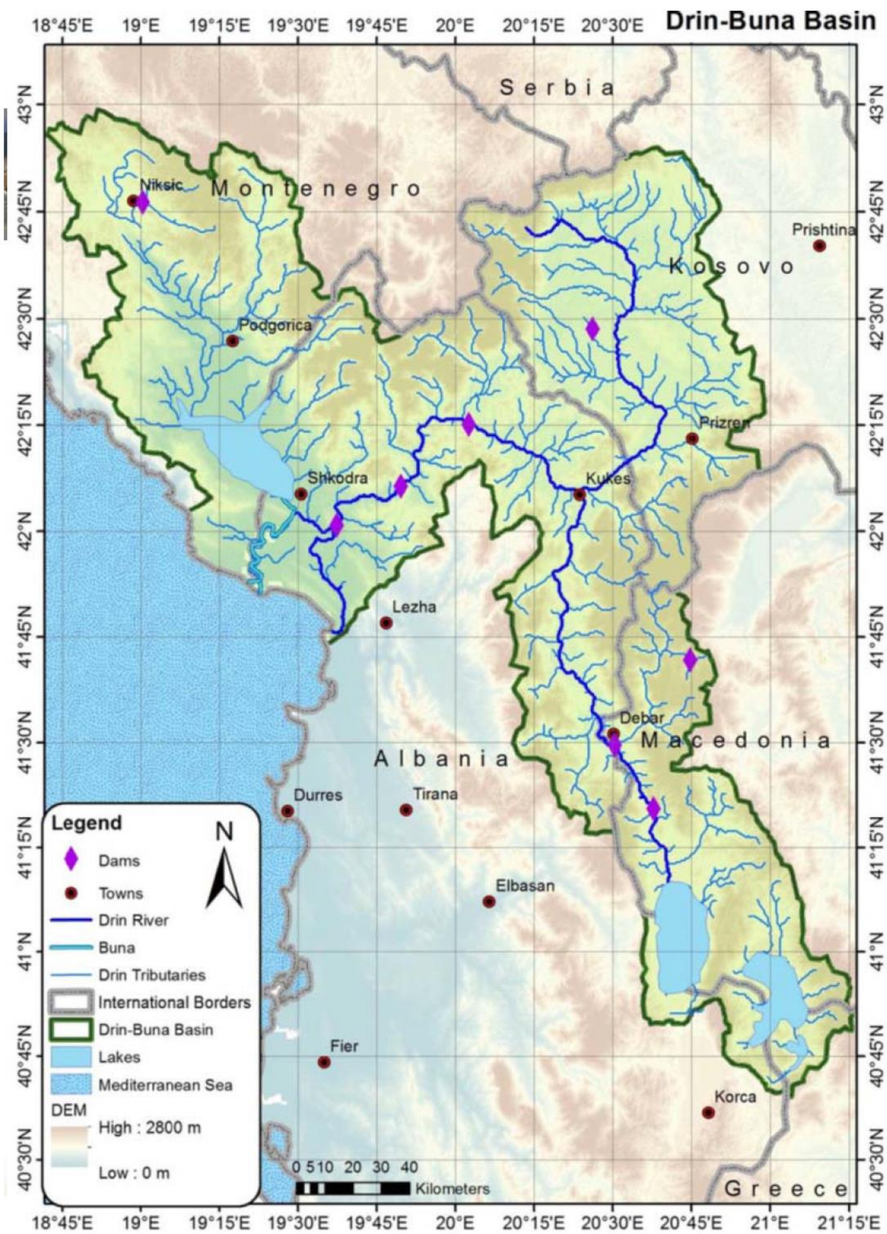

Figure 1: Drin River basin

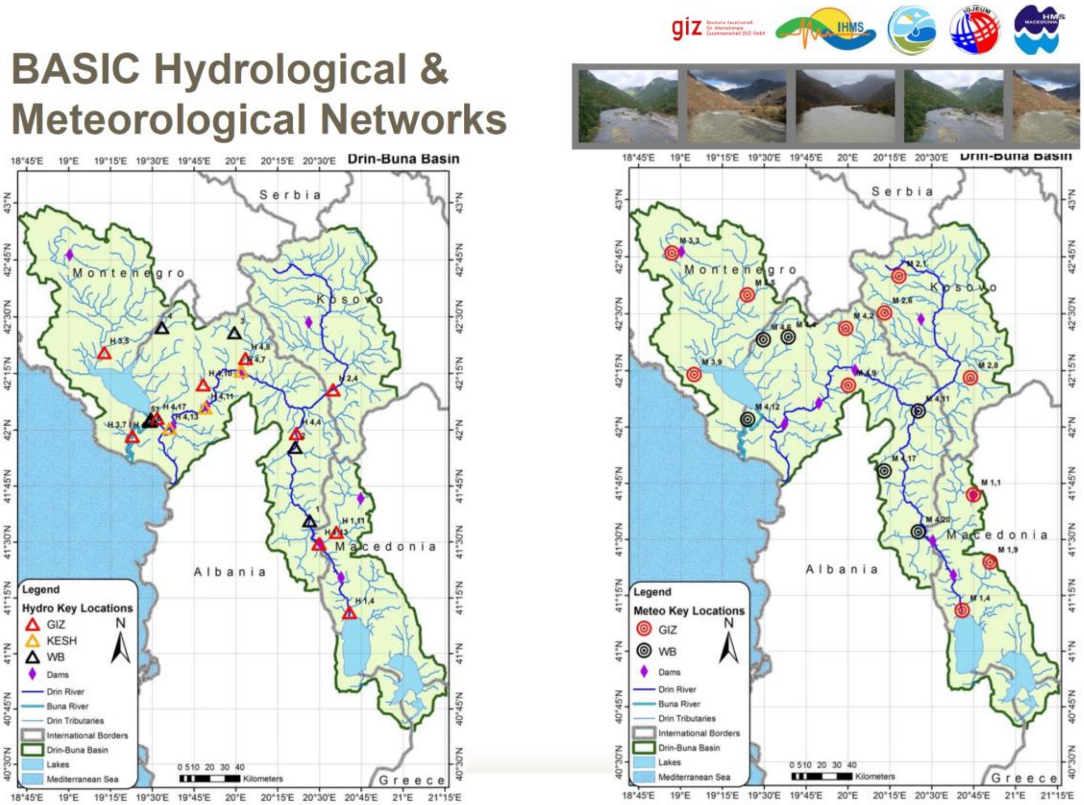

Figure 2: Hydrometric Network of the Drin Basin

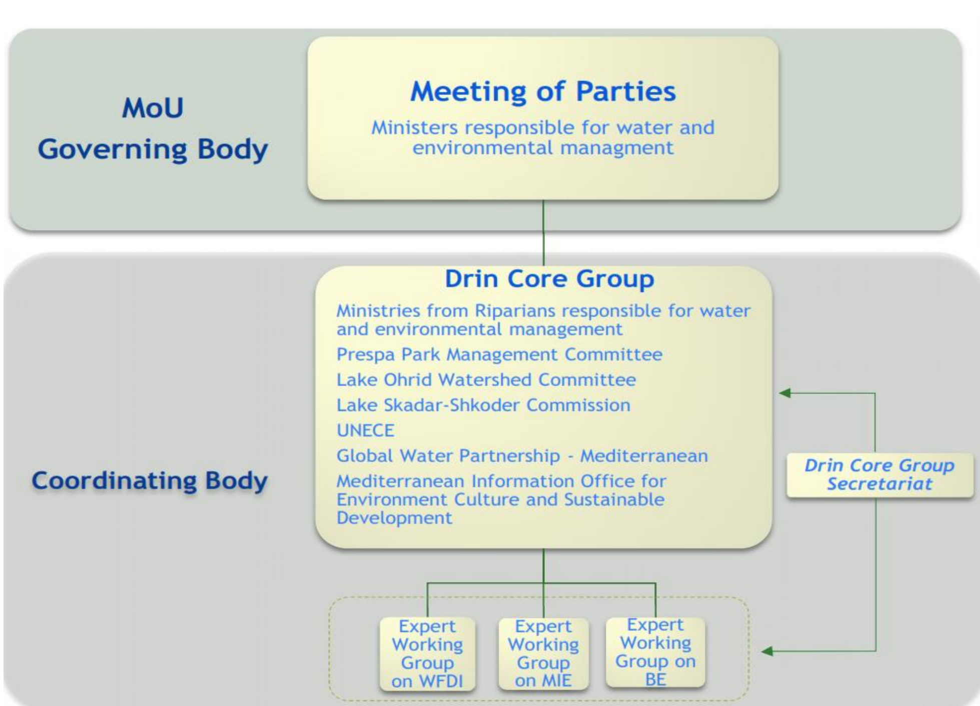

Figure 3: Institutional Framework for the management of the Drin Basin established under the Drin MoU

Annex 2.

Brief outline of flood risks, climate and vulnerability outlook in the individual Drin Basin countries

Albania

In Albania, flooding affects 130 000 hectares of land and is generally pluvial in origin, occurring in the period of November – March, when the country receives about 80-85 % of annual precipitations. The largest floods have appeared in the low western area of the country but small rivers and the torrents cause flash flooding and causes high economic damages. As the urban development of the floodplain increased, the damage caused by flooding also increased. Following the devastating floods of 1962-63, flood defenses were built to the 1% return period in some rivers. In January and December 2010, floods caused major damage and disruption over a wide area. The flooding of January 2010 in the district of Shkodra was at the time considered the biggest emergency event which inundated 10,400 ha of land and about 2500 houses and 4800 people were evacuated. As a result of increasing rainfall, the Drin river flow rapidly increased the water level in three hydropower reservoirs, which were forced to release water, increasing discharge to 2450 cubic metres per second into the Buna River which has a maximum capacity of only 1600 cubic metres per second. The Albanian government declared the flood a "natural disaster" and deployed the army and police forces to help evacuate people.

In Albania, climate change predictions indicate the intensification of heavy precipitation and an increase in the frequency of heavy rains with longer duration, causing flooding and economic damages. Climate change is also increasing the risk of droughts in the summer months due to rising temperatures and variability in rainfall. There is already evidence of increasing frequency of high rainfall, which is increasing pluvial or flash flooding which inundates the floodplain in a matter of hours. In winter, longer duration rainfall causes flooding which lasts for several weeks during the winter period while long-duration spring rainfall combines with snowmelt to cause flooding. Flood risk is a combination of river flooding and coastal flooding due to sea water inundation (storm surges), both of which are increasing with climate change.

The socio-economic vulnerability to climate change in Albania is centered on 4 sectors: agriculture, water, population and tourism. The years with highest recorded incidents of hydro-meteorological disaster are 1995, 1996, 2003, 2004, 2005, 2006, 2007, 2010, 2012, 2013 and 2014. Floods have a significant impact in terms of human life, economy, agriculture and environment. In the 2010 flood which is the largest on recent record, losses reached nearly 0.15 % of the GDP of the country. The average expected losses per year is estimated to be around 370 million of LeK (3.2 million USD), with a maximum of 4 billion LeK (35.2 million USD) arising from the Shkodra flood in 2010. Hydropower is the main source of electricity in Albania, with supply growing by 45.2% in 2015-2016, mainly due to an increase by about 43.4% of hydropower production, from construction and the operation of several small hydropower plants. The country is therefore heavily dependent on hydrological conditions. The Drin is the longest and largest river in Albania and the dams constructed along its way in the Albanian territory, produce hydropower contributing to around 90% of the total electric capacity in the country. Climate change and the increases in risk of both floods and droughts will impact the hydropower sector in Albania.

There has been some progress in Flood Risk Management in Albania. The Flood Risk Management Plan for Shkodra region 2012-2018 aims at improving Flood Risk Management (FRM) focusing on non-infrastructure measures, such as warning systems, preparedness and spatial planning. This includes consideration of all adequate types of measures for preparation, disaster management and recovery phases, as well as the development of a regional flood risk management framework that include local flood risk management plans.

The Third National Communication (TNC) makes the following recommendations for enhanced management of climate-induced flood risk in Albania: maintain efficiency of water evacuation systems; deepen and manage Drin, Mat and Ishëm river flow so that their waters run to the sea; clean, deepen and maintain primary, secondary and tertiary collectors (canals) and draining systems; install and maintain hydrovores during the entire rainfall season; install high power and efficiency pumps for the evacuation of waters from particularly important structures; continuously monitor canals and pipes for the evacuation of communal and industrial waters; plant fast-growing trees to protect river embankments and to mitigate flood risk and soil degradation, and to contribute to climate change mitigation; increase professionalism and efficiency of rescue units (training of existing and new staff); strengthen the role of regional emergency and civil protection units.

Montenegro

Historic data on flooding in Montenegro shows that in the period 1979-1997 there were 5 major flooding events; but in the six years, 2004-2010, floods occurred 6 times (and twice in 2010-January and November - December). Floods are the most frequent natural hazard. Intensive precipitation and snow melting in the northern part of

Moraca basin, combined with high tide in Buna/Bojana river due to the strong south wind and high discharge of Drin resulted in the increase of the water level in Shkoder/Skadar Lake (10.44 m a.s.l.) in December 2010. The December 2010 flood resulted in unprecedented water levels, extent of flooded areas and damages. Total country-wide damages and losses exceeded € 40 million (1.3% of GDP), impacting largely rural areas. Transport routes, electricity supply and communication lines between the northern region and the rest of the country were obstructed for a certain period of time and 1.5% of the population had to be evacuated. Flood damages in areas Golubovci and Tuzi reached an amount of ~2.14 million euros (1.462.500 euros on construction objects and 682,800 euros in agricultural crops).

According to available climate change projections for Montenegro, there will be a sharp increase in variability of river flow, characterized by increased frequency and intensity of flooding and hydrological drought. In addition, coastal flooding and storm surges will also significantly increase. During this period the area of low air pressure develops in the coastal region of Montenegro and has a wide impact causing maximum precipitation in the southern areas. In the karst areas, during spring, there are periodic floods due to longer periods of precipitation, melting snow and reserves of water in the ground. Such floods have impacted the Cetinje plain several times and have caused severe damage to the buildings there.

Given the geo-morphological characteristics of the territory of Montenegro, floods could jeopardize settlements, agricultural areas, forests and other land and transport routes in river plains and valleys. Vulnerability to flooding in Montenegro is due to the location of many towns and settlements on large river banks which makes them potentially more vulnerable to the overflow of water from watercourses. Around Skadar Lake and the Bojana River, as well as on the Cetinje and Nikšić plains the large areas of agricultural land, assets and urban zones are susceptible to flooding. Over 60% of Montenegro's territory is made from carbonate rock. One of the problems facing karst terrains in Montenegro is frequent flooding in karst fields and in the plains of the Zeta Valley, the area surrounding Skadar Lake, and along the courses of the Bojana and Lim Rivers. Extreme floods were registered in late 2010 in the Zeta Valley and along the course of the Bojana River, with maximum levels in Skadar Lake of 10.44m. The floods were exacerbated by reservoirs in Albania (Vaus Deis, Kumana, Fierza), that released 3,000 m^3/s of water into the Bojana River bed which has a capacity of around 1,700 m^3/s, while the overall flow from the Skadar Lake Basin was around 7,000 m^3/s.

In Montenegro, protection from floods has not been given much attention so far, although the consequences for people, property, agricultural land, and critical infrastructure are significant. The Montenegro SNC recommendations for addressing climate-induced flood risks include: strengthening the hydro-meteorological network; better coordination between the government, the Environment Protection Agency and the Institute of Hydrometeorology and Seismology (IHMS) on hydrometric data archiving, establishment of a water information system; data sharing; harmonization of data set standards; clarification of roles, responsibilities and "ownership" of hydrometric data; improvements in flood forecasts; regular maintenance and reconstruction of constructed flood protection structures; map and update a cadastre of hydrogeological phenomena and speleological units; restore, modernise and increase the network of water-measurement stations on karst watercourses; map surfaces endangered by high waters, analyse options enabling the IHSM and the relevant municipal services monitoring priority watercourses; define erosion potential of watercourses; implement a regional project, 'Regulation of Skadar Lake, Drim and Bojana Rivers' establishment of an appropriate operation regime for hydro-power plants on the Drim River and in the Niksic Field to prevent frequent flooding in the territories of Montenegro and Albania (Zeta Valley, Skadar Valley, valleys along the Bojana River, etc)[13]. The proposed project would also assist the government of Montenegro to implement priorities defined by the Strategy for Disaster Risk Reduction for the period 2018-2023 and its associated Activity Plan including local level resilience building measures.

UNDP supported the Ministry of Interior, Sector of Emergency Management (SEM) and Municipalities in the creation of a GIS based platform for flood hazard mapping, for 12 of the flood prone municipalities of Montenegro following the extensive floods in 2010. These maps are based on recorded flooding and not modelled flood hazard, and are therefore of limited usefulness as they do not consider floods of various return periods, and do not take account climate change. However, it is a starting point and a base for further consolidation of data, to the extent it is recorded and available, from past floods.

the Former Yugoslav Republic of Macedonia

The First and Second National Communications on Climate Change outlined a number of scenarios related to water resources. The findings included a projection of a 15% reduction in rainfall by 2050, with a drastic decrease in runoff in all river basins. Although the long-term projection is for increased temperatures and a decrease in sums of precipitation, the past period studied shows significant climate variability, with increased precipitation. The proportion of winter precipitation received as rain instead of snow is increasing. Such shifts in the form and timing

[13] Projects for this purpose have already been designed to implement emergency measures including the cleaning of the Bojana River bed and the building of an embankment along the watercourse bed, SNC

of precipitation and runoff are of concern to flood risk. Since 2002 storms and flash floods have become more frequent in the region and are causing considerable damage. The severe flooding that hit much of the country in January and February 2015 caused widespread damage and economic losses in 44 municipalities. The most affected regions were the basins of the Crna Reka, Bregalnica and Strumica rivers, which cover about 45% of the territory of the country. Roughly 170,000 people were affected in all. In August 2015, flash floods killed six people and caused USD 21.5 million in damage in Tetovo and mountain villages. In August 2016, an intense flash flood affected the suburbs of the capital Skopje (Skopska Crna Gora, municipalities of Gazi Baba, Aracinovo Ilinden), claiming 23 lives, destroying several settlements and causing economic losses of about 30 million Euros.

The two National Communications proposed the following priority measures for adaptation to climate change in the water resources sector and flood risk management: modernization of the hydro-meteorological network; improvement of data availability and the establishment of data monitoring and processing; rehabilitation and reconstruction of existing hydropower and water management structures and systems; development and implementation of effective water management plan; implementation of priority measures related to water supply and irrigation systems, flood and drought control, as well as protection strategies for controlling erosion and sedimentation; restriction of urban development in flood-risk zones; measures aimed at maintaining dam safety, afforestation and other structural and non-structural measures to avoid mudflows; construction of dikes; adjusting operation of reservoirs and lakes (e.g. multiple use of reservoirs to include flood alleviation); land use management; implementation of retention areas; improve drainage; structural measures such as temporary dams, building resilient housing and modifying transport infrastructure; migration of people away from high-risk areas.

The Third National Communication highlights the need for the country to continue accumulating experience to cope with droughts and floods and make best use of existing technologies in water supply and irrigation used in the country. To coordinate these measures more effectively, the report recommends steps be taken to enhance the role of the National Climate Change Committee. The TNC also emphasizes the need for transboundary cooperation to increase the resilience of water resources shared with other countries. Such cooperation will further create opportunities for sharing knowledge and experience and will allow for the exploration of more cost-effective measures. Legislative, regulatory and economic measures can all benefit from a joint transboundary approach.

Annex 3.

Description of Proposed Project outputs

Component 1 – Hazard and risk knowledge management tools
Outcome 1: Improved climate and risk informed decision-making, availability and use of climate risk information

Output 1.1 – Strengthened hydrometric monitoring networks in all riparian countries based on a unified optimized basin-scale assessment of monitoring needs.
Based on a review of the status and adequacy of existing monitoring networks in riparian countries, the optimized network required for basin-scale flood risk monitoring and management will be identified, based on which, the project will design, purchase and implement new/rehabilitated monitoring network throughout the basin. The hydrometric network design[14] document will be prepared covering network design, prioritised station list, condition of those stations, equipment options, rehabilitation / new installation plan, institutional assessment, operation and maintenance procedures and preliminary costing for rehabilitation and O&M.

The project will develop a basin operational plan for the optimised hydrometric network as well as an Institutional capacity development plan for hydrometric network O&M, based on which training of hydrometric specialists with responsibility for operation and maintenance of the hydrometric network in all riparian countries, will be undertaken. The project will establish a unified basin-scale hydrometric database and data sharing protocols across all riparian countries. To ensure sustainability of the rehabilitated hydrometric network, the project will develop financing mechanisms, establishing and safeguarding riparian government long-term commitment of network maintenance, national capacity building for design, installation and maintenance of monitoring networks, linkages to basin and regional monitoring networks, community-managed gauging stations. This will also include the development of innovative financing mechanisms that would seek to engage the private sector (hydropower, tourism, agriculture) for which willingness-to-pay surveys will be conducted during project development, and local government and beneficiary communities (e.g. through engaging local people to assist in maintenance of stations), where possible, to complement government financing.

Output 1.2 - Improved knowledge of climate change induced flood risk, and risk knowledge sharing through the introduction of modelling tools and technologies for the strategic flood risk assessment based on EUFD and development of basin flood hazard maps.
The project will assess current level of implementation of the EUFD in each riparian country and review data availability for the detailed strategic basin-wide flood hazard and risk modelling and mapping. The project will commission/purchase essential datasets and surveys to enable flood risk mapping throughout the basin and will undertake detailed topographic surveys of the river channel through high risk areas in riparian countries, including major infrastructure across the river (e.g. bridges, dams etc.) and along river banks (e.g. flood walls, levees etc.). A unified basin approach to flood hazard modelling based on EUFD will be established and implemented. Using the most appropriate modelling techniques, the project will establish and/or amend existing numerical hydrological and hydraulic models of the basin based on detailed surveys of the physical characteristics of the river basin, and produce high resolution flood hazard inundation maps in line with the EUFD, suitable for use in land use planning, development zoning, flood risk mitigation design, establishment of flood insurance criteria, raising public awareness, and emergency planning. These definitive basin hazard maps will be produced for a number of different return periods and for a range of climate change scenarios and will be the basis of climate risk information for use on climate risk management of the basin. Climate information sharing platforms, protocols and dissemination mechanisms will be strengthened across member countries.

Output 1.3 - GIS-based vulnerability, loss and damages assessment tool and database established to record, analyze, predict and assess flood events and associated losses
Methods, tools and protocols will be established and implemented for the strategic collection of socio-economic data, for the systematic long-term updating of socio-economic flood receptor information (property, land use, economic data, socio-economics information etc.) and community-based risk mapping for the basin. The project will develop and implement a GIS-based basin-wide socio-economic risk model which integrates various spatial socio-economic data with the flood hazard maps, performs vulnerability assessment, and produces high-resolution vulnerability maps for the whole basin which will include damages losses, and loss of life estimates for floods of different return period. The model will enable damage and loss modelling, impact-based flood forecasting, cost-benefit analysis and the appraisal of FRM interventions based on cost-benefit analysis, and development of financing mechanisms for long-term FRM. Using the GIS-based risk model, the project will complete a cost-benefit options analysis for the Drin basin, to identify options that maximise benefits.

To complement the GIS-based risk model the project will develop tools, methods, guidelines and procedures for recording flood events, undertaking post-event surveys and assessing vulnerability to flooding as well as assessing

[14] River water level and flow stations, meteorological station, associated telecommunications equipment.

the effectiveness of flood mitigation measures in reducing vulnerability and damages. The project will establish a basin-wide damage and loss database for recording historical flood damage information (systematic collection of flood depth, damage and loss data, collection, storage and systematisation of historical flood reports across all riparian countries).

Component 2 – Transboundary FRM institutional, legislative and policy framework

Outcome 2: Improved institutional arrangements, legislative and policy framework for FRM, and development of climate change adaptation and flood risk management strategy and plans at the basin, sub-basin, national and sub-national levels

Output 2.1 – Drin River Basin FRM Policy Framework and improved long-term cooperation on flood risk management

The Drin Core Group will be given responsibility for the coordination of the flood management at the Drin Basin level as part of its overall mandate to coordinate the Riparians for the management of the Basin. In this regard, the project will support the operation of the DCG Expert Working on Floods (Drin EWG Floods) during project implementation and will help identify and establish the long-term financing mechanism of the working group as part of the Drin Core Group operation. The Drin Core Group will be the Steering Committee of the project activities of regional nature and will assist in the coordination among countries for the activities of transboundary importance to be implemented at national level. The Drin Core Group with the assistance of the Drin EWG Floods will coordinate the implementation of joint periodic surveys, conferences, workshops, co-working activities.

The project will review existing FM policy and enabling environments in each riparian country and develop basin FRM policies for the implementation of FRM legislative and policy framework in line with relevant EU directives. A key policy to be implemented will be basin wide floodplain zoning/development policy based on detailed hazard and risk maps. In addition, the project will explore and recommend a basin-wide policy for risk transfer mechanisms such as flood insurance (identify appropriate regional insurance model such as Europa Re or develop basin specific flood insurance model based on hazard, risk and damages and losses modelling and mapping – to be explored during the AF project development phase). The project will establish harmonised basin wide sector FRM policies for priority sectors (e.g., agriculture, energy, forest, water management, natural resource use, catchment management).

Output 2.2 – Regional, national and, sub-national institutions (including meteorological and hydrological sectors) are trained in flood risk management, roles and responsibilities clarified and coordination mechanisms strengthened for effective climate-resilient FRM

The project will develop a DRB Stakeholders Analysis and the Governance Analysis focusing on Flood management based on the Stakeholders Analysis and the Governance Analysis done as part of the GEF Drin Project. This will include the following: (i) define all institutions at basin, national, sub-national level involved in water and flood risk management or institutions with activities that impact on flood risk (e.g. forestry, mining, town and country planning, mining, dam owners, and community organisations), including the role of NGOs/CBOs, donors, private sector, women's organisations; (ii) conduct functional analysis of the institutions; (iii) analyze existing resources (staffing and budgetary) including sufficiency of staffing levels, existing capacity and tools; (iv) analyze existing policies, procedures and protocols, national guidance documents or codes of practice; (v) analyze interaction between institutions (e.g. information sharing, cooperation on functional activities, reporting between institutions); (vi) assess access to data and risk knowledge sharing among decision makers, practitioners, government, private sector and civil society, (vii) assess coordination mechanisms and implementation arrangements organised at basin, national and sub-national levels.

Based on the analysis, the effectiveness of institutional arrangements in individual riparian countries towards basin-scale flood risk management will be analysed and if necessary, the ToR of the Drin EWG Floods will be revisited in terms of mandate, membership, resource requirements, technical capacity and technical enabling environment; data sharing and data access and technical means and tools for coordination. In consultation with riparian countries and the DCG a strategy and a five-year work program of the Drin EWG Floods will be developed and implemented. It will describe above all: DRB institutional capacity development plan including, plans for individual riparian countries, the resources, tools, technology, technical guidelines, procedures, protocols and codes of practice for comprehensive basin-scale FRM, the role of the DCG and the EWG in the preparation and implementation of the Drin River Basin Integrated CCA and FRM Strategy.

Output 2.3 – Drin River Basin Integrated CCA and FRM Strategy and Plan Developed

The Drin River basin FRM strategy (FRMS) and plan (FRMP) will be developed for the long-term management of flood risk in the basin. The strategy will establish the high-level basin wide policies for the long-term climate resilient management of flood risk and will be based on detailed strategic climate and flood risk assessment. FRM plan will outline the detailed actions that will be taken to address flood risk at the basin scale and within each riparian country, which will be detailed in national FRMPs. It will include a combination of structural and non-structural approaches which will best address flood risk at the basin scale, and will involve developing an inclusive list of potential options for alleviating flood risk. The project will seek opportunities to attain the right balance between structural (or hard-engineering) and non-structural (or soft-engineering) flood risk management options.

Component 3 – Priority community based climate change adaptation and FRM interventions
Outcome 3: Strengthened resilience of local communities through improved flood forecasting and early warning, implementation of structural and non-structural measures and the strengthened capacity for CCA and FRM at the local level

Output 3.1 – Improved flood forecasting and EWS at the transboundary level to reduce climate-induced disaster risks in vulnerable communities through the establishment of a Drin basin flood forecasting and early warning system
Flood early warning systems offer a solid ground for future integrated warning systems as further advancements in forecasting emerge. Good practice of early warning consists of four key elements: (i) risk knowledge, (i) monitoring and warning services, (iii) dissemination and communication, and (iv) response capabilities. Effective flood emergency response relies on effective flood forecasting and warning, knowledge of where flooding will occur (high risk areas identified by flood mapping), key players in the response, actions to be taken by each individual (or groups of individuals) and an evacuation plan. The work will be based on the enhanced hydro-meteorological monitoring network and risk knowledge delivered under Component 1.

The project will review any existing flood forecasting programmes, or elements of FFEWS in Drin Basin[15], assess current institutional arrangements and capacity for basin-scale flood forecasting, flood emergency response and develop an institutional arrangement plan for FFEWS. Telecommunications studies to determine the requirements to support monitoring and telemetry system as well as warning dissemination system will be undertaken. Flood forecasting models (building on hydrological and hydraulic models established in Output 1.1), will be developed and implemented for a fully integrated FFEWS based on a design to include centralised and community-based Early Warning systems. Training for national, and sub-national practitioners as well as community EWS operators will be undertaken to ensure long-term capacity to operate the FFEWS system. Early warning awareness and training workshops for community, NGOs, government and media representatives will be conducted and national and sub-national flood response and preparedness plans prepared and implemented.

Output 3.2 – Development, design and construction of flood risk structural adaptation and mitigation measures in prioritized areas using climate risk information, and cost-benefit appraisal methods.
The project will undertake feasibility, outline design and detailed design or implementation of structural options. The project will assess new structural measures such as the provision of flood storage, the provision of new embankments and walls, local land raising to elevate development areas above the extreme flood level, local improvements to channel capacity and stability, channel diversions, flow control structures (including pumping and flow diversions), increased maintenance and improvements to channels, e.g. de-silting and dredging.

As part of the development of the FRMS, a long list of options will be examined and qualitatively assessed in terms of the socio-economic, environmental, engineering and hydrological impacts of the options, and will form the basis of the short-listing process to be carried out in consultation with stakeholders. An initial appraisal of the short-listed options will be carried out to determine technical performance in terms of flood damages reduction in the basin. Changes in flood levels against the baseline scenario will also be investigated and the effects of such changes assessed. The reduction in damages resulting from an option (as compared to the baseline) represents the option benefits. A range of options will be directly compared and ranked in order to identify the most economically advantageous options or the economically preferred option(s) for the basin. Feasibility, outline and detailed design studies will be carried out on each preferred option/flood alleviation scheme. The activity will meet relevant national technical standards, where applicable, such as standards for environmental assessment, building codes, etc., and comply with the Environmental and Social Policy of the Adaptation Fund.

Output 3.3 - Strengthened local community resilience to flooding through the participatory design and implementation of non-structural community-based resilience, adaptation and awareness measures

In order to ensure participatory and long-term sustainable community resilience the project will provide training to selected municipalities/communities on maintenance of non-structural intervention measures. Non-structural options will include a suit of measures for management of hillslope and floodplain vegetation to enable greater rainfall infiltration and transmission, and reduce erosion. This may include reforestation and the use of seasonal cropping, agroforestry, the use of vegetative bundles to build flood defences etc., floodplain agro-forestry systems.

[15] The project formulation will examine existing activities, particularly being undertaken by GIZ to better understand planned FFEWS activities for the basin to avoid duplication of effort, and ensure synergy.

Flood risk management measures will promote the re-establishment of natural floodplain functionality including: floodplain reconnection; selective bed raising / riffle creation; washlands/wetland creation; re-meandering straightened rivers; land and soil management activities to retain/delay surface flows; creation or re-instatement of a ditch network to promote infiltration (swales, interception ditches, etc); In-channel vegetation management growth to maximise channel roughness. Income generating ecosystem-based adaptation and FRM measures (e.g. agro-forestry) will be implemented in priority areas throughout the basin. These schemes will form part of the non-structural interventions to be implemented and will be subjected to the same assessment and appraisals of structural interventions as described above.

The project will develop local government response capacity, training first and second responders for flood emergencies through drills and role play exercises and provide training in the operation of EWS where community-based EWS will be established. Training will be provided for communities on roles and responsibilities during flood emergency procedures. Community-based resilience and adaptation will be built using participatory methods of risk assessment and community resilience planning. Community-based response roles and responsibilities will be defined and training of local communities undertaken. Community-managed flood forums will be established.

As part of the FFEWS, community managed EW systems will be established and training undertaken in the operation of such systems to increase capacity of local communities in the maintenance of non-structural intervention measures and the monitoring and issuing of flood warnings in line with established protocols. Information dissemination to reach all beneficiaries will be established, awareness raising and education, and gender mainstreaming approaches established.

Annex 4.

Approach to flood hazard, risk and vulnerability modelling

General Approach

The approach to flood hazard assessment, modelling and mapping will be in line with EU floods directive approach. Flood Hazard maps provide spatially distributed information on flood extent, water depths or water levels, and flow velocity or relevant water flow direction and other information. Flood hazard maps will be produced by numerical modelling of the hydrological and hydraulic routing processes of the catchment.

The hydrological and hydraulic models will enable an understanding of flood response of the catchment and sub-catchments, and will inform the design of flood management/defense options and flood forecasting and emergency response systems. The project will build its modeling work upon the results of the completed and on-going work carried out in the basin through the various technical assistance projects. Existing models will be consolidated/upgraded as appropriate. The following principles will underline the project interventions:

- Developing the modelling tool in consultation with the relevant government agencies in riparian countries
- Using appropriate methods given existing limitations on data availability and quality, while ensuring that these methods will allow for future model development should better/more data become available;
- Creating a tool that may be scaled to include other river basins in the future; and
- Including the ability to model flood risk under baseline, as well and climate change, landuse change and other scenarios

Hydrological Modelling

The purpose of the hydrological analysis will be to model the response of the catchment and sub-catchments to rainfall and to derive flood hydrographs of different return periods (magnitudes). The approach will be tailored to the available data following the initial data review in the proposal development stage. The potential impacts of climate change will need to be considered by modelling a range of climate change scenarios. Rainfall-runoff models of all upstream catchments that feed into the basin will be developed to simulate the runoff response (i.e. hydrograph shape) of these catchments. Rainfall-runoff modelling will be based on catchment physical data (topography, land use, soils, geology) and rainfall event characteristics (observed rainfall timeseries data of specific events, and statistical rainfall parameters when modelling design rainfall). Catchment-scale topographic data is needed to provide catchment physical parameters such as area, slope, stream length etc. for input to the rainfall-runoff model. For this purpose, topographic data of relatively coarse resolution (coarse compared to what is needed for floodplain hydraulic modelling) can be used. This is likely to be freely available global datasets. Rainfall-runoff modelling requires long records of historical meteorological (precipitation, temperature etc.), and hydrological (flow and water level) data at the appropriate spatial and temporal scale (preferably sub-daily). For rapidly responding sub-catchments (flash-flood prone), rainfall-runoff modelling requires sub-daily rainfall and flow data (e.g. hourly) for calibration. Sub-daily rainfall data is also required for development of design rainfall parameters. Hydrological model calibration will be approached by adjusting hydrological parameters that control the percentage runoff, time to peak and rate of runoff as well as baseflow and comparing modelled and observed hydrographs.

Design rainfall is rainfall that defines events of given probability or chance of occurrence (for example the 1 in 100year rainfall or rainfall with a 1% chance of occurring). For design rainfall-runoff modelling, historical rainfall data will be analysed statistically to derive the depth-duration-frequency (DDF) curve which will give the rainfall depth for different return period storms of different durations (or existing DDF curves will be reviewed and used if appropriate). Here, sub-daily data is most appropriate as it allows the derivation of storms of all durations. If sub-daily rainfall data is not available for this analysis, a standard distribution can be used to derive the hyetographs for rainfall-runoff modelling. A rainfall-runoff approach (as opposed to only a statistical approach) is proposed for the development of design flood hydrographs, as it will ensure that account can be taken of the influence of floodplain storage within catchments. Also given the influence of groundwater in some sub-catchments, it will be important to ensure that the rainfall-runoff model is a continuous moisture accounting model which effectively represents the continuous baseflow recharge, which could have a significant impact of the size of the flood. Rainfall-runoff modelling is also best suited to investigating climate and land use change impacts, and for exploring factors such as the travel time of flood peaks, which are important for designing flood forecasting and early warning systems, and for informing disaster response planning which rely on accurate estimates of time of arrival of peak flows. Importantly, rainfall-runoff modelling is most appropriate for modelling the influence of the many reservoirs within a catchment. Statistical analysis of hydrometeorological records will also be undertaken. The hydrographs generated by the rainfall-runoff model will be scaled to match flood peaks derived from a statistical analysis of historical gauge data if data of sufficient length and quality is available to develop an appropriate statistical analysis of flood peaks. If gauged data for the study catchment is limited there may be a need to adopt a regional approach by first extending the analysis to include gauges for hydrologically similar catchments outside of the Drin basin. The resulting runoff hydrographs will be used as input to the hydrodynamic model described in the following section.

Well established hydrological models such as Hec-HMS, US SCS, Probability Distributed Moisture (PDM) model will be reviewed and considered at project inception stage. It is envisaged that Hec-HMS will be used for undertaking the hydrological modelling.

Hydrodynamic Modelling
A hydrodynamic model of each floodplain will be developed to route the flood hydrograph through the channel and floodplain of the study basin. To develop such a model, the main data requirement is high resolution topographic data of the channel and floodplain. Channel topography would ideally be provided by undertaking channel cross-sectional surveys. A topographic survey of the river channel will be conducted, to capture the main changes in the longitudinal and cross-sectional river profile along key reaches. Survey density (cross-section spacing) would normally vary depending on whether the area is highly populated or more rural to ensure that the highest risk areas are well covered. Whether an area has historically flooded is also a key factor, as well as future flood risk under climate change. Hence in the unpopulated and low risk parts of the basin, cross-sections survey spacing can be sparse, while in densely populated areas or areas of historical flooding, or likely to flood in the future, it would be desirable to have cross-sections more closely spaced. These guidelines can be tempered by the variability of the channel profile in these areas. It may be necessary to forego cross-section surveys in some areas altogether and extract the data from the floodplain DEM for constructing the model in these areas. Alternatively, if the channel profile is changing very rapidly, closer spacing might be required. In some low-lying areas, where floodplain flow dominates or where the channel bed is exposed during floodplain DEM surveys, cross-section surveys can also be foregone (but not in high risk and heavily populated areas which tends to be on these low-lying floodplains), if DEM data of an appropriate resolution and accuracy is available for floodplain modelling. It should be noted that any cross-section surveys that may be carried out as part of this study will be a ‘snap-shot’ in time of the channel profile. Given the geomorphologically active nature of the river, this survey will become out of date in time and in some cases, it would be important to ensure that a programme of regular channel surveys is implemented particularly at gauging stations, critical infrastructure and along active reaches. Any existing survey or as-built drawings for existing structures, as well as any reports on the original design would be useful to help to characterise structures such as bridges, and other structures across the river, as well as any linear structures such as existing river walls. Typically channel topographic surveys could take months to be completed, particularly for large areas and where seasonal weather conditions might hamper surveys. A detailed scope of the channel surveys will be developed at the start of the project and surveys will be scheduled based on the order in which basins are to be modelled.

Higher resolution DEM data for detailed hydraulic modelling of floodplain flows. The intention is to acquired Light Detection and Ranging (LiDAR) data the floodplains, the cost and feasibility of which will be assessed at concept stage. This high-resolution DEM would provide significantly enhanced accuracy for the hydraulic modelling in comparison other sources. Using all topographic datasets, baseline models of the floodplain of the river basins will be developed, that represents the current catchment conditions, including current operation and maintenance practices for any structures on the main channel and floodplain as well as linear flood defences that influence the movement of water between the channel and floodplain as well as all reservoirs in the basin. The baseline model will be used to assess the existing standard of protection (i.e. the minimum size of the event for which flooding occurs) within the catchment, provide clarity on the current flooding mechanisms, and serve as a baseline against which the economic appraisal of proposed interventions can be made. The baseline model will need to utilize a mixture of 1D and 2D modelling techniques, based on the combined topographical datasets (i.e. floodplain DTM, channel and hydrographic survey data, if available). Appropriate channel, floodplain frictional resistance values can be estimated from photographs, land-use maps and site visits. Key structures of significance to flow conveyance will be identified for inclusion in the model, and data on operational control of dams and other gated structures will be utilized. The hydraulic model will need to be calibrated and verified in tandem with the hydrological model by varying channel and floodplain frictional resistance and structure discharge coefficients values until good agreement is obtained between modelled and observed levels and flows at key gauging locations or observed flood extent maps derived from historical flood surveys and satellite imagery. Calibration to historical events will need to be undertaken in the hydrological model, ensuring that the modelled runoff hydrographs fit the observed as closely as possible. Depending on the availability of data, calibration of the hydraulic model will be done to fit observed flood levels and extents at key locations for which observations are available. This will include anecdotal information from the communities affected by flooding, which will be collected as part of the community surveys. Anecdotal information will also be collected using participatory GIS methods where possible. All data available for calibration will be reviewed and ascertained during the early stage of the project to confirm this approach. The extent of the detail with which the system can be represented will depend on the available data, including data that can be realistically collected during the study period. It is envisaged that the level of detailed representation within the model will vary along the various reaches within the catchments and from sub-catchment to sub-catchment. The hydraulic model will be created to ensure that the urban and important agricultural areas and those identified as significant to the cause and/or effect of flooding, are well represented. Where necessary, less significant reaches and sub-catchments may be modelled using simple routing models which will link into the more detailed hydraulic reaches. Should risks be identified or more detailed information (like channel surveys) become available for the reaches designated as less critical at this time, the model could be easily updated to enable full hydraulic modelling along these reaches. It is important to note that model accuracy will be dependent on the quality of the input data, the extent of detailed topographical representation and the accuracy of modelling assumptions. Three significant sources of error may be the accuracy and spatial resolutions of the topographic data used to build the model, choice of model parameters such as roughness (frictional resistance) and discharge coefficients, particularly for over bank flows. The calibrated and verified hydraulic model will be used to run design events of different annual probability (return period) of occurrence, to produce flood maps.

There is currently a wide array of commercial modelling packages, for example, Info works (1D and 2D by Innovyze, formerly HR Wallingford), MIKE (DHI), HEC-RAS 1D and 2D (USACE), Tuflow, SOBEK 2D and Flo2D packages to name a few. These and other tools typically provide a map-based interface to the underlying models, and survey data, models, time series data and asset information can easily be added as it becomes available. The choice of modelling software will be agreed among the riparian countries and will consider any existing modelling software being used, as well as regional modelling approaches.

Risk and Vulnerability Modelling and Mapping

The approach to risk and vulnerability assessment, modelling and mapping will be in line with EU floods directive approach. Baseline socio-economic assessment and preparation of flood vulnerability map will be based on baseline hazard mapping, combined with infrastructure (bridges, roads and buildings), land use (settlements, agriculture, grazing lands, and conservation areas), property and socio-economics data, to assess the socio-economic impacts of all hazards and produce vulnerability maps for the river basin. This vulnerability map, based on the accurate hazard mapping of the current situation will form the baseline. In order to develop vulnerability maps, a GIS-based risk modelling tool will integrate the various spatial socio-economic data with hazard maps, and produce vulnerability maps which will include economic losses and damages and loss of life estimates. Large hydro meteorological events often result in losses to infrastructure, particularly roads and water supply, losses to agriculture and damage to property, along with concomitant social effects associated with loss of potable water and agricultural productivity. The baseline socio economic appraisal will concentrate on these and other sectors. Agricultural damage per unit of area will be calculated based on land use, typical crop yields and current market values. The loss of dwellings will be valued based on the type of structure. For example, for temporary dwellings the cost of building materials, the number of days labour for rebuilding will be important whereas damage to permanent buildings will be based on an average value, established through local consultation and proportional damage by flood depth to buildings and their contents will be estimated.

The probability of the loss of life and injury will be valued based on the density of population, average hazard severity (e.g. flood depth and velocity). This will then be multiplied by a reference valuation for the statistical economic loss of life. Costs for the rebuild of damaged major infrastructure will be included, as well as the costs for post event aid relief, based on the historic records for previous events. Care will be taken to include but not double count, the gender effects of disasters. It is known that the consequences for the balance between productive and reproductive activities of women is severely altered during and post the hazardous event. This has impacts on the household income and the resilience of the household.

It will be important though challenging, to assess the macro economic effects of hazards on the basin economy and that of each riparian country. All sources of damage and loss will be incorporated through mapping to generate Economic Vulnerability maps. As discussed above, this will involve land use, density of population, agriculture and major infrastructure and buildings. From these maps, the potential damages caused by a range of severity of events can be produced for the baseline condition, by comparison with the maximum hazard extent/severity.

Under the GEF project the basin socio-economic data has been collected and analysed with GIS and this will be an important starting point for the analysis of flood risk and vulnerability. During project proposal development and project inception phases, any necessary additional data collection will be determined, before developing and implementing the GIS-based flood risk and vulnerability model as described above.

Annex 5.

Dam Safety and Potential Role in FRM

The Hydropower dams in the Drin basin and their reservoirs are of great importance to the economy of the riparian countries. They are the main sources of electricity in Albania and contribute to electricity production in the Former Yugoslav Republic of Macedonia. They could be used for seasonal and long-term regulation of river flow. In this regard they can have a positive effect on or exacerbate river flooding in case reservoir operation don't integrate climate risk information. The Hydropower sector will therefore be an important stakeholder as well as beneficiary of the climate risk information and basin level climate risk management that the project will implement.

Dams, by their very nature, create risks, which may increase substantially under climate change. Poor maintenance could lead to reservoir sedimentation which would reduce flood storage and change channel morphology and can thus exacerbate flooding. Poor maintenance or catastrophic hydrometeorological events could ultimately lead to catastrophic failure or breaching of dams, and this risk will increase with climate change.

The operation of hydropower dams and reservoirs within the basin will be included in the flood risk assessment, modelling and mapping. Based on climate risk information, the project will assess the current and long-term ability to operate dams in a flood alleviation role. This will require the involvement of dam owners and operators in the development and eventual implementation of the overall flood management plan for DRB, and the development of individual operating rules for each dam during floods, which meets the dam safety requirements, and which also fits into the DRB basin flood management plan. This will therefore involve optimisation of the dam operations for multiple uses including power generation, flood alleviation and dam safety. At the very least, it should be ensured that dams are operated in a manner which avoids exacerbation of the flood risk, and which takes account of the increasing risks they pose due to climate change.

The engagement of the dam owners and operators will be sought actively at the project preparation phase and then later during the project with the aim to have them closely and extensively engaged in all activities to which they can contribute. A stakeholder analysis will lead to the development of a stakeholder engagement and communication plan during the project implementation. The engagement and communications plan will highlight to the hydropower companies the potential benefits from their participation in the activities towards enhanced flood risk management supported under the project e.g. optimisation of dams operation taking into consideration climate change as well as the operation of cascade of dams in neighboring Riparians. As the hydropower companies are among the most important stakeholders, the project will strive to include them in the consultations and discussions with national authorities towards the empowerment of the institutional arrangement - the Expert Working Group on Floods will be established in 2018 - in the framework of the Drin Core Group, for effective flood risk management. In addition, in developing risk financing mechanisms the project will seek to engage the private sector including the hydropower sector and will conduct willingness-to-pay surveys and detailed consultation, to better understand how the hydropower (and other sectors) will contribute to and benefit from comprehensive basin FRM.

Annex 6.

Potential Risk Financing Mechanisms

Risk financing in riparian countries, is mainly from central and local government budgets, which suffer from limited financial resources compared to the annual average damages and losses that can be incurred from flood events and the expected increase in damages and losses under climate change. The lack of financial capacity undermines ability to carry out statutory central and government functions and the ability to enforce regulations against harmful practices and activities, such as development in the floodplain, the uses of flood resilient building codes for houses and other structures, thus increasing exposure and vulnerability of people, structures and economic activity in built areas and agricultural and natural landscapes. There is limited to no involvement of the private sector in climate risk financing in riparian countries, despite the large damages that would be incurred to the private sector from flooding.

A key barrier to the establishment of adequate climate risk financing is the lack of climate risk information to quantity likely damages and losses under current and climate change conditions as well as the ability to undertake the economic analyses to fully understand the investment priorities to address the risks. The project will address this barrier by establishing basin level socio-economic assessment, risk planning and risk financial and investment planning for addressing flood risk. Furthermore, the project will provide the means for identifying the necessary budget requirements for addressing flood risks, and for national and local level private sector engagement in establishing risk financing schemes.

The main risk transfer mechanism that will be considered is flood insurance. In 2008, the World Bank launched the regional lending program to support the establishment of a regional catastrophe reinsurance company with the aim to contribute to the development of a catastrophe insurance market in Southeast Europe and Caucasus that would provide homeowners and small and medium-sized enterprises (SMEs) with the opportunity to purchase affordable catastrophe and weather risk insurance coverage to address the high vulnerability to natural disasters in SE Europe. In 2009, in order to implement the World Bank program of lending and technical assistance for the development of the regional catastrophe insurance market, the countries of the region created Europa Reinsurance Facility Ltd. (Europa Re) - a special catastrophe and weather risk reinsurance company. Albania, the former Yugoslav Republic of Macedonia and Serbia are the major shareholders of the company. The project, through the development and establishment of climate risk information, will assist the Riparians in developing the policy and enabling environments to fully participate in the Europa Re insurance and the local communities that reside in high flood risk areas to benefit from the provided services. The project will also examine whether Payment for Eco-system Services (PES) schemes will be relevant, particularly associated with the agro-forestry and other community-based schemes being implemented.

Annex 7.

Knowledge Management and Learning

The knowledge management (KM) of the project will have the following key aims:

1. To ensure access to data and information generated by the project as well as long-term access to data on which stakeholders' essential institutional functions rely and/or data and information that can be used for evidence for policy and practice advice (**connecting people to information and knowledge**)
2. Connect key stakeholder groups, practitioners and experts to ensure that key learning and experience is shared within and across sectors (**connecting people to people**)
3. Ensure staff in the stakeholder institutions know about effective and relevant KM techniques so that knowledge is shared, captured and retained by the institutions and shared within and across the sector (**institutional KM improvement**)
4. By developing and promoting KM as a tool for continuous and sustainable improvement and ensuring that KM tools generated by the project will be systematically used and maintained within the stakeholder institutions (**Developing and embedding KM tools and practices**).

Connecting people to Information and knowledge

The project will build on the foundation of previous knowledge. New knowledge gained on the project will be captured and stored appropriately for others to access and learn from. The following series of tools and techniques will be employed to enable people to find information and knowledge more effectively throughout the project.

a. *Case Study* – At least 5 case studies will be generated per year of the project
b. *Rapid Evidence review* – Project inception studies will establish the project baseline which will be updated throughout the project as it progresses and published in various technical and non-technical documents.
c. *Knowledge Banks (web databases)* – The project will develop a knowledge and data management website for all project, stakeholder and beneficiary staff

Connecting people to people

The following series of tools and techniques describe how knowledge management will enable people to connect to people more effectively.

d. *Community of Practice (CoP/Knowledge network/professional network)* – The project will set up a number of technical working groups, riparian countries' interagency working groups as well as regional working groups to enable practitioners (CoP) to interact and share experiences
e. *Peer Assist* – The project will engage a range of local and international experts who will provide technical assistance to the project. For long-term peer assist, the project will help establish relationships between institutions and local as well as international universities and research centres
f. *Knowledge café* – This will be achieved through the meetings of the technical working groups and through bi-lateral meetings between individual stakeholder organisations
g. *Knowledge marketplace* – This will be provided by project experts who will be identifiable by their area of expertise and will provide support to the project and stakeholders. In the long-term, a 'directory' of experts can be developed to fill this need.

Institutional KM improvement

Summarizing lessons learnt and experiences and sharing them with others can help build and retain knowledge. The following series of tools and techniques describe how the project knowledge management will enable improvement through impact assessments, evaluations and people management.

h. *Gone well/not gone well* - All significant project events/activities will be subject to a debrief to capture good/bad points and lessons learned
i. *After Action review (AAR) formative evaluation* - All significant project events/activities will include formal minutes which will be made available on project portal
j. *Retrospective review (summarise evaluation)* - A formal project lessons learned document will be available for all project staff to complete (managed by PM) online
k. *Knowledge Exchange* - All project staff will have as final deliverable a summary report to include knowledge transfer information and other lessons learned

Developing and embedding KM tools and practices

During project formulation and planning, the number and types of Knowledge Management tools that will be developed will be further detailed.

As far as possible, all KM tools will be provided as project deliverables and, importantly, through the project it is intended that by using these tools with the stakeholders, the KM practices will be embedded within their organisations in the future.

In addition to the above the project will provide many opportunities for formal learning, awareness raisings and capacity building cut across almost all outputs and activities. These sets of measures will catalyze longer-term learning and short-term professional training/retraining programs targeting all stakeholders, including vulnerable communities, local governments, schools and universities and, relevant authorities.

All knowledge products, generated within the project including technical reports, methodological guidelines, regulatory and policy, planning and outreach materials will be available on-line, and all project knowledge products and documents will be collected and archived on e-library on multi-hazard disaster risk management.