International experiences on the formulation and implementation of transboundary climate change adaptation strategies

MEKONG RIVER COMMISSION
MRC
FOR SUSTAINABLE DEVELOPMENT

International experiences on the formulation and implementation of transboundary climate change adaptation strategies

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ACRONYMS & ABBREVIATIONS

ACTO	Amazon Cooperation Treaty Organization
ASEAN	Association of Southeast Asian Nations
CCAI	Climate Change and Adaptation Initiative
COMESA	Common Market for Eastern and Southern Africa
EAC	East African Community
EFD	European Floods Directive
EU	European Union
ICPDR	International Commission for the Protection of the Danube River
ICPR	International Commission for the Protection of the Rhine
IWRM	Integrated Water Resources Management
LMB	Lower Mekong Basin
M&E	Monitoring and Evaluation
MASAP	Mekong Adaptation Strategy and Action Plan
MRC	Mekong River Commission
NBI	Nile Basin Initiative
SADC	Southern African Development Community
UNECE	United Nations Economic Commission for Europe
WFD	Water Framework Directive

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EXECUTIVE SUMMARY

The Mekong River Commission's (MRC) Climate Change and Adaptation Initiative (CCAI) aims at formulating the Climate Change Adaptation Strategy for the Lower Mekong Basin. An important first step in developing this strategy is to review international experiences of existing strategies, to learn from their process and their implementation, and to derive recommendations for a Mekong Adaptation Strategy and Action Plan (MASAP).

This report provides a review of existing transboundary/basin-wide adaptation strategies. Relevant international basins and regions worldwide were first identified for the review. At the basin level, adaptation strategies of four basins were selected for review, including the Nile, Danube, Rhine and Neman. At the regional level, adaptation strategies of four regional cooperation organisations were reviewed – the Association of Southeast Asian Nations (ASEAN) adaptation strategy, the Common Market for Eastern and Southern Africa-East African Community-Southern African Development Community (COMESA-EAC-SADC) Climate Change Adaptation Strategy for the water sector, the European Adaptation Strategy, and the Amazonian Strategic Cooperation Agenda.

The analysis in this report is based on the framework and steps for the development of an adaptation strategy, which is derived from the United Nations Economic Commission for Europe (UNECE) Guidance on Water and Adaptation to Climate Change. A comparison was made between the UNECE framework and the CCAI framework.

The review was based on the following aspects:

- the **overall formulation process**, which examines, *inter alia*, how the strategy was developed, the parties involved, the duration of the process and the time horizon of the strategy;
- the **enabling environment**, which looks at hindrances to adaptation. The enabling environment includes the policy, legal and institutional frameworks within which the strategy is developed;
- the **information used and required**, including the information management, the impact assessment and the vulnerability assessment;
- the **goals, objectives and measures** of the strategy;
- the **implementation, monitoring and evaluation** of the strategy.

The review finds that initiatives for developing an adaptation strategy generally rely on the collaboration between the involved ministers, often ministers responsible for water management, and the transboundary institution responsible for coordination. Through the mandate, the parties

can ensure that their interests are included in the process.

The first step in developing the strategy is usually a study on the climate change vulnerability of the basin or region. This is mainly achieved by compiling the available studies and drawing generic conclusions from them. Based on the vulnerability assessment, adaptation measures are identified, usually in broad terms, to enable adjusting these measures to the local conditions.

The process of developing the adaptation strategy is generally carried out in close cooperation between the countries including the joint body, and representatives and experts of the individual countries at the national level. Usually also a broad range of stakeholders are involved through meetings and workshops. The process of developing an adaptation strategy is considered continuous as changing circumstances, due to climate change, socio-economic and demographic developments, and changes in vulnerability and the relevant measures may change. In practice, this implies that an adaptation strategy once developed is reviewed every five to ten years to account for the changing environment. To make sure that both the process and the resulting strategy are relevant, efficient and effective, and have the expected impact, the process should be continuously evaluated.

The time needed to elaborate the strategy, the time between the adoption of the mandate to develop a strategy and the adoption of the strategy by the parties, varies between one to six years. This depends, among others, on the available information and the extent of the mandate (e.g. a detailed versus a more generic strategy). In general, a period of two to three years is needed, but can be shortened when much of the preparatory work has been finalized, for instance on the vulnerability assessment.

The climate change outlook to be included in the strategy usually extends to 2050. A longer time horizon is, however, useful when the strategy includes measures that imply long-term investments, for example, for infrastructures. The infrastructures should therefore be built so as to account for the longer-term projections of climate and other changes. Moreover, since climate change projections become more uncertain as they extend further in time, a time horizon of 2050 with some outlook until 2100 seems an appropriate approach.

An important issue is to consider an integrated approach where the strategy is mainstreamed in the relevant policies. This will avoid contradictory policies and hindrances to implement specific measures.

Benefits of transboundary cooperation are generally ignored or taken for granted. It is recommended to explicitly clarify the expected benefits of the joint strategy to ensure better implementation of the strategy.

Financing of the measures comes from the national budgets and from donors, depending on the economic situation in the countries. The Danube river basin strategy, for instance, has incorporated the implementation of the strategy in the process of implementing European Union (EU) directives, where the funding largely comes from national budgets. The EU strategy is aiming at directing funds to adaptation. The COMESA-EAC-SADC strategy aims at improving the access to international funds.

The mandate adopted as well as the involvement of government representatives in the process of developing the strategy should ensure that the strategy is in line with the respective national policies and legislation, including international agreements. If it appears that the existing policy and/or legislation contradicts the goals and objectives of the mandate or the strategy, reconsideration of these policies and legislation should be included as part of the measures of the strategy. Also, adapting the institutional arrangements may be part of the strategy. The COMESA-EAC-SADC strategy, for instance, explicitly aims at capacity building and improvement of the institutions.

An important element in developing the strategy is that there is agreement on the impacts and related vulnerabilities. This entails exchange of all relevant information and extended communication about scenarios and projections between the parties.

The generic objective of the strategies is to reduce the vulnerability of society and ecosystems to climate change and improve resilience. The specific goals and objectives for each strategy reflect the priorities of the parties in the different strategies and are rooted in the differences in historical, geographical, political, and cultural contexts of the respective countries.

Measures specified in the various strategy documents include both structural (e.g. protective dams) and non-structural (e.g. regulatory and economic instruments) measures. An important development in defining measures is the recognition of ecosystems as an adaptation option, either restoration and preservation or as a green infrastructural measure.

The strategy should include an implementation plan to guide the implementation of the strategy and a monitoring and evaluation (M&E) plan to be able to keep track of the implementation. The M&E plan is also needed to ensure that if the climate change effects differ from the initial projections, the planned measures can be adapted to the changes. For this reason, it is also recommended to regularly revise the strategy. The strategy should therefore be valid for a period of five to ten years.

The report ends with an overview of conclusions and recommendations for the development of the Mekong Adaptation Strategy and Action Plan (MASAP).


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1 INTRODUCTION

1.1 Background of the study

Addressing climate change impacts and developing adaptation strategies and action plans for a large river basin are challenging tasks. They require long-term modelling of the impacts of climate change on the basin's water resources and environment, and must derive robust basin-wide adaptation strategies and action plans to protect the health of its ecosystem and economic prosperity, as well as the welfare of its riparian countries and people. To be effective, these strategies and plans need to be part of the riparian national policies and take into account the rapid changes in those transitional economies. Some international river basins authorities have had climate change on their agenda for a long time, while others have been taking the first steps toward a basin-wide adaptation process.

The Mekong River Commission's (MRC) Climate Change and Adaptation Initiative (CCAI) started implementation in August 2009 as a regional collaborative initiative to support Lower Mekong Basin (LMB) countries in adapting to the impacts and new challenges of climate change. In adopting a basin-wide integrated approach consistent with Integrated Water Resources Management (IWRM) principles and the MRC 1995 Agreement (MRC, 1995), the CCAI focuses on:

- climate change impact and vulnerability assessment, adaptation planning and implementation in priority locations within the LMB;
- knowledge and capacity development at different levels (institutional, technical and managerial capacity);
- regional adaptation strategy supporting national frameworks;
- regional partnership and collaboration.

CCAI, among others, aims at formulating a Climate Change Adaptation Strategy for the LMB. A thorough concept has been drafted outlining the process of the strategy development. An important first step in this outline is to succinctly review international experiences of existing strategies, to learn from their process and their implementation, and to derive recommendations for a Mekong Adaptation Strategy and Action Plan (MASAP).

This report provides a review of existing transboundary/basin-wide adaptation strategies, summarising lessons learnt and recommendations for the LMB context, and compiling good practices and case studies in the format of fact sheets.

1.2 Process

This report was developed by identifying international basins or regions with an adaptation strategy, developing aspects to review, creating a template to describe the basins and regions, compiling good practices in terms of process and implementation, formulating recommendations for the MRC MASAP and writing the report. Based on the overview of International basins of the Oregon State University (OSU, 2012) (also see Annex 1) and a quick Internet scan, international basins with an adaptation strategy were identified. In addition, through a review of other documents, adaptation strategies of regional cooperation were also selected for a review. This has led to the selection of basins, including the Nile, Danube, Rhine and Neman, and regions, including the ASEAN adaptation strategy, the Common Market for Eastern and Southern Africa-East African Community-Southern African Development Community (COMESA-EAC-SADC) Climate Change Adaptation Strategy for the water sector, the European Adaptation Strategy, and the Amazonian Strategic Cooperation Agenda.

The framework of the UNECE Guidance on Water and Adaptation to Climate Change (United Nations Economic Commission for Europe [UNECE], 2009) was taken as the basis for the review used in this report. The specific aspects were derived from the Guidance, and an Excel sheet was developed to include the relevant information for each aspect of the individual basins and regions. Further, a template was developed for the description of the basins and regions, linked to the review aspects. The respective templates are annexed to this report.

2 OBJECTIVES OF THE REVIEW

The review aims to provide MRC's CCAI with lessons learnt from experiences in other international basins and regions. These lessons will help the CCAI develop an adaptation strategy for the Lower Mekong Basin (LMB), providing CCAI with overall insights and examples. The specific objectives for the review are:

- To carry out a thorough search of international experiences regarding transboundary/basin-wide climate change adaptation strategies, evaluating information on the formulation process, the content of a strategy, linkages of such strategies with basin planning and with national adaptation planning and strategies, experiences with implementation of the strategy, and examples of finance mechanisms.

- To provide a critical assessment of the strengths and limitations of the reviewed transboundary/basin-wide adaptation process, to formulate lessons learned, and derive recommendations for the development of the Mekong Adaptation Strategy and Action Plan (MASAP).


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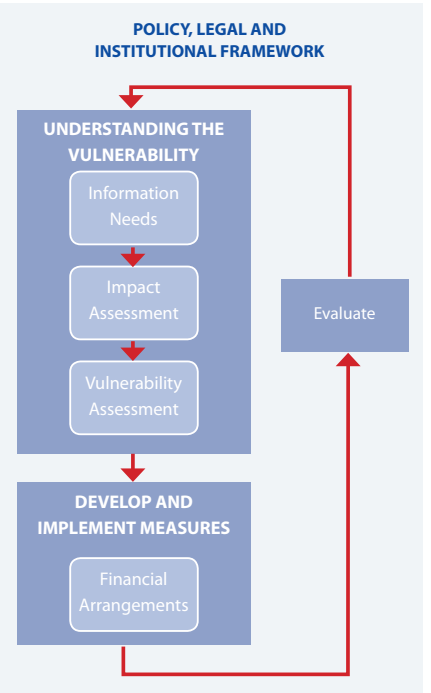
3 REVIEW METHODOLOGY (ANALYTICAL FRAMEWORK)

3.1 Basic framework

The analysis in this report is based on the framework and steps for the development of an adaptation strategy, which is derived from the UNECE Guidance on Water and Adaptation to Climate Change (UNECE, 2009) (Figure 1) and which will be further developed along the lines of the CCAI framework for developing an adaptation strategy (MRC, 2011) (Figure 2). The UNECE framework describes the various steps that need to be taken to develop an adaptation strategy. These steps are embedded in the 'enabling environment' consisting of the policies, the legal framework, and the institutional framework within which the adaptation strategy is developed. The development of the strategy consists of a continuous repetition of two main consecutive blocks of activities:

- Understanding the vulnerability;
- Development and planning of implementation of measures.



The process of developing an adaptation strategy is considered continuous as changing circumstances, due to climate change, socio-economic and demographic developments, and changes in vulnerability and the relevant measures may change. In practice, this implies that an adaptation strategy once developed is reviewed every five to ten years to account for the changing environment. To make sure that both the process and the resulting strategy are relevant, efficient and effective, and have the expected impact, the process should be continuously evaluated.

Figure 1. *Framework and steps for the development of an adaptation strategy (UNECE, 2009)*

Understanding vulnerability consists of determining the necessary information, making an impact assessment, and developing the actual vulnerability assessment. The information needs include determining what the objectives are and what information is needed to determine them. The impact assessment includes, with the aid of scenarios and models, a description of the possible impacts in terms of the physical environment of climate change in the short, medium and long term. The vulnerability assessment finally entails determining the socio-economic and environmental impacts of climate change.

The activity of development and implementation of measures, i.e. the actual adaptation strategy, includes identifying **relevant measures to decrease vulnerability**. An important element of this step is determining the financial arrangements needed to be able to implement the plan, the actual plan to implement the measures, and the necessary steps for the implementation of this plan.

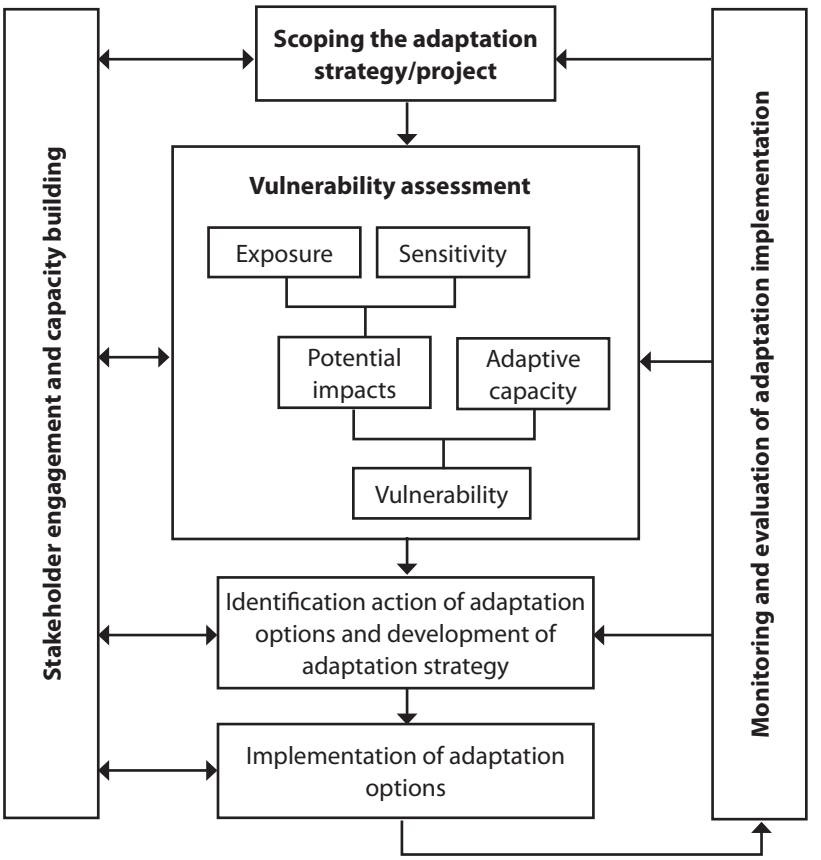


Figure 2. *CCAI Adaptation Planning Process (MRC, 2011)*

CCAI's approach to developing an adaptation strategy involves the following components of the adaptation planning process (MRC, 2011) (Figure 2), which are comparable to the UNECE framework. The first component is the scoping of the adaptation framework, allowing the Mekong Adaptation Strategy to address the highest priorities and can be integrated into national and regional policies for sustainable development of the Mekong River Basin. This component is comparable to the enabling environment in the UNECE framework and includes an evaluation of the existing policy, legal and institutional framework. Care should be taken that this component not only steers the adaptation planning process, but also that the resulting measures may include changes in the policy, legal and institutional framework.

The next component in the CCAI framework, the 'Vulnerability Assessment', involves an assessment of the present situation, including the current status of populations and institutions with respect to vulnerability to current climate risks, and assessments of efforts to adapt to them. It also involves assessing future climate risks, developing scenarios on future climate, vulnerability, socio-economic and environmental trends as a basis for assessing future climate risks. Particular attention will be paid to addressing gender issues and the significant vulnerability of women, children and older members of the population. This component is comparable to the activity of understanding vulnerability in the UNECE framework.

Formulating a LMB adaptation strategy and action plan, the third step in the CCAI framework, involves the creation of a set of flexible adaptation policy options and measures in response to current vulnerability and future climate risks. This is a major part of the activity of development and implementation of measures in the UNECE framework. The UNECE framework for this activity pays special attention to the financing mechanisms for the adaptation strategy, which could be an essential addition to the CCAI framework. Continuing the adaptation process building on the existing adaptation activities, the CCAI framework supports the adaptation implementation. This component is also included in developing and implementing measures in the UNECE framework.

The component of monitoring and evaluation in the CCAI framework is comparable to the continuous evaluation in the UNECE framework and is an important component to keep track of the adaptation planning process as well as possible external (climate, demographic, policy, etc.) changes that must be addressed through the planning process.

Engaging stakeholders in the adaptation process is an important component in the CCAI framework, thus creating and sustaining an active dialogue among affected people and groups. It is also one of the core principles of the UNECE framework, although it is not included as a separate element. Stakeholder

involvement is crucial for the successful implementation of adaptation strategies. This component will also include an assessment of existing capacities for adaptation and capacity building to strengthen efforts to better cope with climate change. The UNECE framework considers the adaptive capacity as part of the enabling environment and addresses this issue by formulating measures to build sufficient capacity and include training where necessary.

Both the CCAI and UNECE frameworks address the same issues but show some differences in emphasis. The major difference between the framework seems to be that the policy, legal and institutional framework, which steers the adaptation planning process in the CCAI framework through the scoping component, while part of the process in the UNECE framework and, as a consequence, may be altered by the process.

3.2 Aspects to review

As stated, the aspects to be reviewed are identified based on the above-described frameworks. In summary, the review will focus on the following five aspects:

- the overall formulation process;
- the enabling environment;
- the information used and required;
- the goals, objectives and measures of the transboundary adaptation strategy;
- the implementation and M&E of the strategy.

The various strategies will be analysed using a qualitative comparison, looking at similarities and differences between the strategies and the effects in particular of the differences. These are also viewed in light of the specific context of the strategy. Where relevant, available literature will also be included.

The first aspect concerns the overall formulation process. This includes issues such as: how the strategy was developed; what parties were involved; how long the process took; and what the time horizon of the strategy was. It also looks at whether the process is embedded in IWRM principles, if the strategy will be mainstreamed in the relevant policies and if it is based on an integrated approach. Also, the way the process shares the costs and benefits among the parties involved will be also reviewed. Finally, the size of the strategy document is noted.

The second aspect concerns the enabling environment. In effect, it reviews hindrances in adaption, which would turn it into a 'blocking' environment. The enabling environment consists of the policy, legal and institutional framework within which the strategy was developed. The policy framework

includes the overall policy on which the strategy was developed and the range covered by the policy: Does it look solely at water management or are other societal issues covered as well? Moreover, it considers: the accountability of developing the strategy, which links to the legal aspects; the transparency of the process, linking to the information exchange under the other aspects; and if participation was included in the process and at what level. Here, we also look at the international element: is there a common policy between the countries and how does it relate to the national policies? Are there international commitments in place, for instance, the UNECE Water Convention, the Aarhus Convention and the Ramsar Convention?

The legal aspects looks at laws and agreements that are in place and that may influence the development of the strategy in a positive or negative way. This considers whether the existing agreements allow for flexibility in, for instance, redistribution and/or periodic review of water allocations.

The institutional framework looks at the institutions that were involved in developing the strategy. Here, an important issue is the presence or absence of a river commission or other joint body that guides the process. Furthermore, the national institutions involved will be taken into account, but also capacity building that allows the stakeholders to understand the process and the mechanisms to enable them to act effectively. Finally, the communication on the process to the wider public is taken into account.

The third aspect concerns the information used and required. This includes the information management, the impact assessment and the vulnerability assessment. The information management aspect concerns the information used, how it is collected, and how this information is exchanged among the countries and/or institutions involved. The impact assessment element looks at the use of scenarios and models, and whether they are harmonised throughout the basin. The vulnerability assessment aspect considers whether the assessment is targeting the physical, economic and/or social vulnerability.

The fourth aspect is the adaptation goal, objectives and measures. Element of this aspect looks at the types of strategies and measures taken (structural or non-structural; aiming at prevention, improving resilience, preparation, response or recovery; long-term, medium-term or short-term). It also looks at how uncertainty is included in developing the measures and if cost-benefit analyses were used for the identification of measures. Regarding the implementation of measures, it will have to be determined whether there is an implementation plan and the sufficient financial resources. The latter includes, inter alia, cost recovery schemes, insurance and reinsurance schemes, funding assistance, and use of ecosystem services.

The fifth aspect concerns the implementation and M&E of the strategy. This examines whether the strategy is monitored and adaptive, that is, flexible enough to be changed under changing circumstances (e.g. climate change occurring sooner or having different characteristics than anticipated or measures showing unanticipated effects). If the strategy is already implemented or under implementation, the experiences derived from this implementation will also be reviewed.

4 OVERVIEW OF TRANSBOUNDARY ADAPTATION STRATEGY DEVELOPMENT WORLDWIDE

An inventory of transboundary river basins around the world shows that there are few transboundary basins or international regions that have developed or are in the process of developing an international adaptation strategy (Table 1 and Annex 1). In many basins worldwide, the individual countries have developed or are developing national adaptation strategies but not transboundary ones.

Table 1 Number of transboundary river basins with an adaptation strategy (as of July 2014)

Continent	No. of transboundary river basins [1]	No. of transboundary river basins that have an adaptation strategy	No. of transboundary river basins that are developing a strategy
Asia	19	0	0
Africa	59	1	0
Europe	69	1	3
North America	40	0	0
South America	38	0	0

(1) As listed in OSU (2012)

For this report, eight basins and regions that have a climate change adaptation strategy under development or in place are selected for a review (Table 2). The selection is based on a quick scan through the Internet, through information received from the UNECE Task Force on Water and Climate, and from CCAI, and from the strategies known to the reviewers.

Table 2 | Basins and regions included in the review

Basin level	
NILE - NBI Climate Change Strategy (2013)	A Climate Change Strategy for the Nile basin was developed, based on an assessment of its climate change challenges in the basin. The strategy aims at exchanging of information, increasing awareness on climate change, mainstreaming of adaptation into different sector's policies. Coordination and support is provided by Nile Basin Initiative (NBI).
Danube River (ICPDR) Adaptation Strategy (2013)	An adaptation strategy was developed based on a vulnerability assessment, which consisted of a synthesis of existing studies. Implementation is carried out by the Parties to the International Commission for the Protection of the Danube River (ICPDR) through the ongoing six-year cycle of River Basin Management Plans (RBMP) and Flood Risk Management Plans (FRMP). The strategy includes guiding principles and recommendations for countries.
Rhine River Adaptation Strategy (ICPR) (under development)	The Rhine Ministers Conference (28 October 2013) decided to develop a climate change adaptation strategy based on the information developed over the years on possible impacts and the floods in the Elbe and Danube Rivers in 2013. This is an example of slowly developing awareness and consequent action.
Neman River adaptation framework (2013)	This is an example of a more bottom-up approach, where through a project under the UNECE Task Force on Water and Climate and on the basis of stakeholder meetings, a vulnerability assessment, a common information platform and a strategic framework were developed for adaptation. This framework is currently being adopted by the respective governments not only for adaptation purposes, but also to further improve the general water management in the basin.
Regional level	
ASEAN Adaptation Strategy (2012)	The ASEAN Adaptation Strategy is an action plan that covers adaptation, focusing on sharing information and developing a work programme to address loss and damage, mitigation, issues on finance and investment, transfer of technology, and capacity building. The respective countries have committed themselves to implement the strategy.

COMESA-EAC-SADC Climate Change Adaptation Strategy for the Water Sector (2011)	On the basis of an impact assessment, an adaptation strategy was developed to improve climate resilience in Southern Africa. Responsibility for the strategy is vested through the Council of Ministers in a Tripartite COMESA-EAC-SADC reporting structure.
European Adaptation Strategy (2013)	An overall strategy was developed in order to stimulate action by Member States on climate change adaptation, building on existing policies and legislation. The strategy aims for better informed decision-making and climate-proofing EU action. The strategy is a framework for coordination, includes a financing mechanism and a monitoring, evaluation and review mechanism.
Amazonian Strategic Cooperation Agenda (2010)	A Cooperation Agenda was developed towards the joint use, protection and conservation of the resources in the Amazon region. The Agenda extends to all relevant sectors in the region and includes water resources.

Note: *The selected basins are all multilateral basins.*

An earlier inventory on the application of IWRM in transboundary waters also concluded that addressing the impacts of potential climate change in transboundary basin management is limited (Hooper & Lloyd, 2011). They found that "some IWRM practices were well developed (for example, stakeholder participation and some aspects of coordination); while others were limited (e.g. those addressing the impacts of potential climate change in basin management, water quality management, environmental flow provisions and environmental assessments)" (ibid., p. v). One of the reasons is that the institutional context, also connected to political and administrative leadership, and organizational capacity and financing, largely determine possibilities of transboundary water organizations to develop cooperation (Hooper & Lloyd, 2011).

Climate change research has been conducted in most of the river basins, the majority of which face substantial climate change impacts in the not-too far future. In some cases, an adaptation approach is included in the overall water management plan, which however, risks becoming too narrow an approach. In other cases, current water management already poses substantial challenges, and adaptation is not yet considered.

One issue that may be of relevance is that in many international basins there is no transboundary treaty in place for the river basin (see Annex 1). This hinders development of a strategy. Historically, basins in climates with highly variable hydrologic conditions face more frequent events of conflict, while the riparian

of rivers with less extreme natural conditions have been more moderate in their conflict/cooperation relationship. This is not a straightforward relationship (Yoffe, et al., 2004), but in general, basins with more variable hydrological conditions may benefit more from having a treaty and presumably a joint water management strategy. Also, larger, multilateral basins are much more likely to have a treaty in place than bilateral basins (M. Giordano, et al., 2013).

And yet, only some basins that have a treaty are working towards an adaptation strategy. In few basins, there are specific strategies, for instance, to maintain populations of certain fish species such as Salmon or Sturgeon, but these do not specifically targeting climate change. In addition, there are specific strategies for a single topic; for instance, in part of the Amur basin, an adaptation strategy is developed to maintain the ecological integrity of the Dauria region.

Literature shows that treaties that have developed from dealing with issues such as hydropower, water allocation and irrigation are shifting towards environmental issues. Treaties also increasingly include data and information-sharing provisions, and include mechanisms for participation beyond traditional nation-state actors. There is consequently a tendency towards more comprehensive treaties cooperatively addressing the issues (M. Giordano, et al., 2013). In addition, basins shared by nations that are economically, environmentally and politically more stable are usually better suited to be more hydro-politically resilient (Petersen-Perlman, et al., 2012), and cooperation is better in basins where relatively strong institutions are in place (Wolf, 2009).

In the overview of strategies presented in Annex 1, the only the international adaptation strategies that are included are those that deal with water management or have a broader perspective and that are endorsed by governments.

A quick review of the transboundary river basins in the Asia-Pacific region revealed that, with the exception of the LMB, there have been no specific attempts to develop an integrated adaptation strategy. Nevertheless, the 2012 ASEAN Action Plan on Joint Response to Climate Change provides at least one example for the region and is relevant for the Mekong River Commission.

5 FORMULATION PROCESS

5.1 How was the strategy developed?

The initiative for developing an adaptation strategy is generally an interplay between the involved ministers, often ministers responsible for water management, and the transboundary institution responsible for coordination. Examples of such initiatives are the ASEAN Statement on Joint Response to Climate Change (ASEAN, 2010, 2011), the Danube Declaration (International Commission for the Protection of the Danube River [ICPDR], 2010), the Action Plan on Floods (International Commission for the Protection of the Rhine [ICPR], 2009) and Communiqué of Ministers (ICPR, 2013) for the Rhine. In the ASEAN case, it was the ministers of foreign affairs. The result of this interplay is a mandate for the transboundary institution to develop a strategy.

The Neman basin case is different because there is no transboundary institution. In this case, an international project, Management of the Neman River Basin with Account of Adaptation to Climate Change, was started to assess the vulnerability. The result of the project is a draft adaptation strategy that is proposed to be adopted by the riparian countries.

Once a mandate is given to implement it, depending on the capacity and mandate of the transboundary institution, one of the countries is appointed to take the lead in developing the strategy (e.g. Thailand in ASEAN and Germany in the Danube River) or the transboundary institution (e.g. NBI in the Nile River, ACTO in the Amazon River, and the European Commission in the EU).

The first step in developing the strategy is usually a study on the vulnerability of the basin or region. There are already many studies available on various levels, and the basis for the strategy is mostly built by compiling them and drawing generally conclusions from them. In the Danube basin, many of the countries already developed National Adaptation Strategies that provided a good basis for the strategy (Prasch, et al., 2012). In the EU, an impact assessment was made on the basis of wide-ranging consultation and from a broad spectrum of scientific and policy expertise (EC, 2013b, 2013c; European Environment Agency [EEA], 2012). In the Nile basin, the process involved comprehensive consultations and workshops at the regional and national level (Nile Basin Initiative [NBI], 2013). In the Rhine basin, the relevant information is collected through research from individual countries as well as studies commissioned by the ICPR.

Based on the vulnerability assessment, adaptation measures are identified. In many cases, the measures are broadly described, leaving much room for the individual countries to fill in the measures (e.g. ASEAN, but also Danube

basin). The measures can thus be tailored to the local conditions. In other cases, the measures can be quite specific (e.g. EU and Neman basin). This will be discussed in more detail below.

It should be noted that the UNECE Guidance (UNECE, 2009) explicitly mentions the enabling environment and the importance of including the policy, legal and institutional framework in the development of a strategy. This was explicitly included only in the Neman basin case because the Neman basin project was based on the UNECE Guidance. In the other strategies, this was not explicitly accounted for. For basins such as the Rhine and the Danube, which have extensive experience in cooperating, the policy, legal and institutional framework is already rather well attuned to that cooperation. Explicitly studying and evaluating these frameworks is less relevant for these basins. For a basin like the Nile, where cooperation is still in its infancy, explicit evaluation of the policy, legal and institutional context in view of the adaptation strategy would have been beneficial, because adaptation measures could include improving one or more elements of the enabling environment.

5.2 What parties were involved?

According to the UNECE Guidance, the knowledge, capacity and views of everyone involved in the strategy are crucial to ensure sound, effective and sustainable adaptation (UNECE, 2009). Moreover, it is important to involve all relevant stakeholders because excluding specific groups can lead to creating new, unintended problems (J. G. Timmerman, 2005). Also, participation is expected to lead to greater legitimacy for the policies (due to the spread of responsibility) and to improvements in policy implementation (due to a readier acceptance of policies in which stakeholders and the public have participated) (Gooch & Huitema, 2007). This notion is reflected in the processes included in this study, where in developing the strategy in the various cases, a range of stakeholders are involved. Nevertheless, distinction should be made between performing an integrated assessment, as in the case of developing an adaptation strategy, and local planning, as in the case of implementing the strategy (Ridder & Pahl-Wostl, 2005).

Participation is explicitly mentioned in all strategy documents. On the one hand this is done by describing the stakeholders that were involved in the development of the strategy, on the other hand by referring to stakeholders that should be involved in the implementation of the strategy.

For transboundary river basins, the process of developing the adaptation strategy is generally carried out in close cooperation between the countries, which entails the involvement of representatives and experts of the individual countries at the national level in addition to the coordinating institution (a transboundary institution, a country or, in case of the Neman basin a project). In addition, various stakeholders are involved in the process,

such as regional international organisations (in the case of the COMESA-EAC-SADC region), regional authorities within the countries (in the case of the Neman basin), sectoral stakeholders such as business organizations and non-government organizations (NGOs) (in the case of the EU and Amazon basin), and international experts (in the case of the Neman basin).

Involvement of stakeholders is usually achieved through workshops. During the process, different stakeholder groups are invited to participate in one or more workshops. In the case of developing the EU strategy, an online public consultation was also organised.

The level of participation depends on the level of the strategy. If the strategy is aimed at giving guidance, participation can be limited to some extent. For the EU strategy, for instance, active participation was sought with country representatives, business organisations and NGOs. This would, in general, be the appropriate level because the strategy does not deal with local issues. Nevertheless, the EU organised the possibility for individual citizens to respond. For the Neman basin, on the other hand, detailed measures are included. In this case, regional authorities as well as individual businesses were involved. This is the appropriate level because the measures are concrete enough to have an immediate effect on specific stakeholders.

5.3 How long did the process take?

In most cases, the actual development of the strategy took some three to four years; the ASEAN case took some six years to complete. In the Danube and the Rhine cases, the development of the strategy document took around one year. In both cases, the strategy was developed by the secretariats of the respective basin commissions. Also, in the Amazon case, the process took one year. Here, a strategic agenda was developed that will be further developed over the coming years. The agenda was developed by the joint body.

In all cases, it is difficult to determine the exact time needed, because this depends on a range of factors. The EU strategy, for instance, was preceded by two policy documents, which, if included as part of the process, expands the timeframe. The Neman case could not build on existing vulnerability assessment studies, and the time needed for making this assessment is included in the overall time to develop the strategy.

It can therefore be concluded that there is no specific time that the development of a strategy should take. This depends on many factors such as the level of cooperation, the general agreement among the riparian countries on climate change, and the availability of climate change information, but also, for instance, on the extent to which stakeholders are already involved in cooperation activities and possible legal arrangements for this involvement.

5.4 What is the time horizon of the strategy?

Most cases take a time horizon of several decades, often until 2050. In some cases, the strategy is developed for a shorter period of time and will be revised after that period. Usually, this revision is explicitly mentioned.

A longer time horizon is useful when the strategy includes measures that imply long-term investments. Infrastructure, for instance, is built to last up to 50 years and often even longer. Also, renovation or replacement of infrastructures often has a long planning horizon. The infrastructure should therefore be built to account for the longer-term projections; i.e. the strategy must be robust in view of the longer-term expected changes. Since not all measures will be implemented at once, regular revision of the strategy, based on the actual changes and latest insights, will help to adapt the planned measures accordingly.

Also, it may be useful to take a long time horizon because, in some cases, the projections for the longer term deviate from the shorter term. For the Rhine River, for instance, the flow regime is not expected to change much up to 2050. The glaciers in the Alps are expected to retreat, and after 2050, the flow regime becomes more rainfall- dominated, with summers with lower discharges, and winters with higher discharges (Görgen, et al., 2010). The projections, however, become more uncertain as they extend further in time. A time horizon of 2050 with some outlook until 2100 therefore seems to be the appropriate approach.

5.5 Is the process embedded in integrates water resources management (IWRM) principles or based on an integrated approach?

IWRM is defined by the Technical Advisory Committee of the Global Water Partnership (GWP) as "a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems" (GWP-TAC, 2000, p. 22). It deals with the management of surface and subsurface water in a qualitative, quantitative and environmental sense from a multi-disciplinary and participatory perspective. There is a focus on the needs and requirements of society at large with regard to water at present and in the future, thus aiming at maximum sustainability in all senses (GWP-INBO, 2009; GWP-TAC, 2000; Jaspers, 2003; Jønch-Clausen, 2004). It is therefore an important element of an adaptation strategy. Only an integrated approach that goes beyond disciplinary divides can provide adequate policy concepts and strategies to cope with collective action problems in international river and lake basins (Schmeier, 2010).

All cases claim to take an integrated approach; some are explicit about IWRM principles (e.g. Neman and Danube). The EU implicitly takes IWRM on board through its reference to the Water Framework Directive. Others, like Nile and Amazon, only mention the integrated approach. In all these cases, it is important that the integrated approach also be reflected in the selection of measures and the implementation plan to prevent the strategy from being hindered by policies in other related sectors.

5.6 Will the strategy be mainstreamed in the relevant policies?

In the long term, climate change adaptation needs to be supported by an integrated, cross-cutting policy approach that is not separated from other policies (UNDP-UNEP, 2011). The effectiveness of climate policy can be enhanced and policy coherence improved if the inter-linkages with other policy fields are strengthened while also supporting the other policy areas (Kok & de Coninck, 2007). Climate change adaptation should therefore be integrated into policy development, planning, programmes and budgeting, across a broad range of economic sectors. This process is generally called 'mainstreaming' (UNECE, 2009), which is therefore an important element of an adaptation strategy.

Most cases explicitly mention mainstreaming and include other sectors and policies. Nevertheless, it should be understood that a push for mainstreaming from the water management perspective is not always adopted in other policy fields. This is consequently a matter of national policies to decide whether climate change adaptation needs to be mainstreamed.

5.7 Sharing the costs and benefits among the parties

Cooperation between countries can have important positive effects for the countries involved. It can: help overcome inequity in access to water; lead to more efficient and sustainable use of water resources, for instance, through joint management plans; create mutual benefits and better living standards through, for example, increased food and energy production; and facilitate the exchange of data and information. In addition, cooperation can: help develop joint management strategies to preserve water resources and protect water-related ecosystems; overcome cultural, political and social tensions; and build trust between communities, regions and states. Cooperation can also reduce costs related to tensions between riparian states and can pave the way to much greater cooperation between states, and even economic integration among states (Sadoff & Grey, 2002; UN-Water, 2013). One example of cost sharing among riparian countries is in the River Rhine, where the countries jointly financed measures to reduce pollution caused by French potassium mines (Dieperink, 2011; Mostert, 2003).

Costs of measures are in general mentioned in the various strategies but not further specified. The measures are usually not specified on a level that would enable an estimation of the costs. Only the Neman Strategy provides a list of specific measures and links cost estimations to the measures. None of the strategies includes mechanisms on sharing of costs.

The issue of possible benefits is not specified. Only the Nile Strategy and the Neman Strategy explicitly mention the aim of realizing and sharing benefits. The Amazon Strategic Agenda mentions benefit sharing for biodiversity and biotrade, targeting a specific element of the basin. A more explicit search for and identification of benefits will increase the success of the strategy.

5.8 Financing mechanism

Without a good financing system, transboundary river basin management is not viable in the long term (Raadgever, et al., 2008). Sufficient resources should be available to ensure sustainable implementation of the measures. Financial as well as ecological sustainability can be improved by recognizing water as an economic good and recovering the costs as much as possible from the users. The latter can be directly linked to the intensity of use, making the users aware of the consequences of their activities, and helps to avoid overexploitation. However, equity considerations need to be taken into account (J. G. Timmerman, et al., 2011).

Four different types of funding can be distinguished in addition to donor funding (Sweden's Ministry of Foreign Affairs [SmoFA], 2001):

1. Direct funding from taxes and charges. Levying taxes or charges to support transboundary water management services is complicated and not yet present in transboundary water management.

2. Private sector investments. The role of the private sector has been limited in financing water management; most has been in water supply and sewerage, and much less so in sewage treatment. The private sector investment most relevant to transboundary water management has been in hydropower.

3. Endowment or trust funds. Trust funds offer a plausible option for sustaining transboundary river institutions and longer term planning and programming.

4. Inter-riparian financing. This concerns investments made by some riparian countries in activities that are implemented in the territory of other countries. One case is the water quality programme on the Rhine where the water quality programme pollution abatement measures from the French salt mines were paid for by the lower riparian

countries. For the Netherlands, for instance, in the 1960s and 1970s, it was considered cheaper to invest in pollution abatement in France than in water purification in the Netherlands.

Generally, water management is paid from general taxes. Solidarity in the basin might entitle upstream countries to share some portion of the downstream benefits that their practices generate, and thus downstream countries share the costs of these practices. Payments for benefits (or compensation for costs) in the context of cooperative arrangements could also be considered, although this is not the norm in international treaties. Costs can be shared according to economic principles, where the party that gains most pays most, or according to other criteria (UNECE, 2009).

The EU strategy and the Rhine and Danube basin strategies largely base their funding on the existing mechanisms, where basically, the funding comes from the countries. The EU strategy allocates some funds for countries to implement the strategy. The EU strategy also promotes improving "the market penetration of natural disaster insurance and to unleash the full potential of insurance pricing and other financial products for risk awareness, prevention and mitigation and for long-term resilience in investment and business decisions" (EC, 2013a, p. 2). The Rhine and Danube make use of these and additional EU funds for specific activities. The Neman basin strategy has identified a series of measures including their potential funding sources. The sources range from national budgets (sometimes even specific national programmes are mentioned) to EU funds and other international funds. The Amazon Agenda looks both at national and international funds. The other strategies mainly look for international funds to finance implementation, such as the Global Environment Facility (GEF), the United Nations Framework Convention on Climate Change (UNFCCC) process and the World Bank.

5.9 Size and content of the strategy document

The size of the strategy documents range between eight pages (ASEAN) and 118 pages (COMESA-EAC-SADC). The ASEAN document is a plan of action that mainly describes the objectives and actions envisaged in headlines (ASEAN, 2013). The COMESA-EAC-SADC document is a specified programme of action, describing in detail the work plan and issues such as budget, terms of reference, and stakeholder consultations (SADC, 2011). There is no ideal size for a strategy document, because this depends on the goals of the document and the target audience.

The contents of the strategy documents vary among the different strategies. In general, the strategies discuss the following topics:

- an introduction describing the background of the strategy, the policy context of the strategy and occasionally, the legal context;
- an overview of the current problems or challenges, and the projected impacts of climate change;
- the objectives in the strategy;
- the guiding principles for the strategy, which includes issues such as participation, IWRM, gender, equitable use of the resource, etc.;
- the actions/activities that are envisaged and their expected outcomes;
- an implementation mechanism including a coordination mechanism, the communication between the parties and the financing of the implementation;
- a monitoring, evaluation and review mechanism. In some strategies, a description of the M&E mechanism is provided; in others, the M&E mechanism is included as one of the first activities to be developed under the strategy.

6 ENABLING ENVIRONMENT

6.1 The policy aspects

Adaptation policy planning should consider and prevent possible conflicts between different water-related sectors. Inappropriately designed adaptation in water management can affect other policy areas, such as energy, health, food security and nature conservation. For instance, the increased use of reservoirs may under some conditions create breeding grounds for vector-borne diseases, and the increased use of water for irrigation may lead to lack of water for the river's ecological functions (UNECE, 2009).

There is also a linkage between adaptation and mitigation. There are five pragmatic suggestions for broadening climate policy to take into account the linkages between adaptation and mitigation (Swart & Raes, 2007):

1. Avoid trade-offs when designing policies for mitigation or adaptation.
2. Identify synergies.
3. Enhance response capacity by enhancing the generic capacity to both adapt and mitigate through non-climate policies.
4. Develop institutional links between adaptation and mitigation.
5. Mainstream adaptation and mitigation considerations into broader sustainable development policies.

Policies in place should enable the development and implementation of the strategy. This entails that the policies recognise climate change as a potential problem and support adaptation to climate change. The way the policies define the problem and the solutions may differ significantly among countries and over time. Water policy in the Netherlands, for instance, has changed from a strict water safety perspective, building infrastructures such as dykes to protect the land from flooding, to a 'living with water' perspective, where there is room for more natural processes, among others, through creating more floodplains (Room for the River Programme) (OECD, 2014; Zevenbergen, et al., 2013). The adaptation strategy will need to reflect these policies. The process of developing the adaptation strategy should therefore include a review of the existing policies. From this review it should become clear whether the relevant policies account for climate change, and whether or not the measures defined contradict the policies. It is therefore also important to involve stakeholders from different sectors in the process. One of the problems that may arise is that certain policy areas may not allow for certain measures. This may hinder implementation of the strategy. If such a situation is acknowledged during the development of the strategy, one of the adaptation measures could be to start a process to adopt the respective policy.

Looking at the reviewed cases, the development of most of the strategies is based on decisions by the country representatives, mostly ministerial representatives. The strategies are consequently implicitly based on the respective countries' policies. The presence of a transboundary institution entails a policy of cooperation in the riparian countries and the joint development of an adaptation strategy fits in with this policy. The objectives of the strategy to be developed are subject to the approval of the countries as is the final strategy. This ensures consistency between the national policies and the regional strategy because this is the responsibility of the country representatives. A pitfall is that the country representatives, often from an environmental or foreign affairs ministry, have not coordinated sufficiently with other relevant ministries; an explicit review of the respective policies can help to avoid this pitfall. In the Danube basin, for instance, the current national adaptation strategies were explicitly taken into account in developing the strategy.

The only exception in the reviewed cases is the Neman basin, where there is no transboundary institution. Here, the project that was started and that was approved by the respective governments, turned out to be acceptable for adoption at the government level (but still has to be effectuated). Given the situation that there was no initial country representation, an explicit assessment of the relevant policies was made in the Neman basin. In turn, with the adoption of the joint strategy, the strategy is also aimed to influence the respective national policies, especially concerning water management.

The various strategy documents describe the steps taken in the process of developing the strategy and the institutions and stakeholders involved. Moreover, most of the documents also describe the steps in implementing the strategy and how participation should take place. In this way, the process becomes transparent, and account can be taken of how the results were achieved. Transparency and accountability are necessary components of the strategy because they enable acceptance of the strategy by both countries and stakeholders. The Nile explicitly mentions transparency and accountability as overarching principles, and the Danube explicitly mentions transparency. The other documents do not specifically mention these terms, but fill in the aspects by providing the relevant information.

6.2 The legal aspects

The legal aspects of a transboundary adaptation strategy are important. "Legislation should not present barriers for adaptation, and should be flexible enough to accommodate continuing environmental and socio-economic changes" (UNECE, 2009, p. 3). This holds true for the national and international level. There are five core elements to be addressed in transboundary water treaties – scope, substantive rules, procedural rules, institutional mechanisms

and dispute settlement (Wouters, 2013). These elements have to be able to accommodate the implementation of the strategy.

All reviewed cases refer to and build on existing national and international agreements. The strategy can be considered an interpretation and implementation of the goals of the agreements. Many of the reviewed cases stress the importance of flexibility of the strategy, due to the uncertainties of climate projections and the possibilities to adapt the strategy to changing conditions and projections. If the agreements on which the strategy builds contain strict rules on water allocations, this can hinder the needed flexibility of allocations under climate change. When agreements do not allow for the necessary measures, improving them can become part of the strategy. This situation of improving the agreements is, however, not encountered in the reviewed cases.

6.3 The institutional arrangements

For formulation and implementation of transboundary strategy, clear and strong institutional arrangements are needed. The important elements of institutional arrangements include good water-related information and basin models, are based on basin-wide policies, procedures and strategies, include communication and participation (e.g. regular meetings and information on the process), and have an agreed approach to monitor and report progress in and outcomes of the work of the institution (Hooper & Lloyd, 2011). Some of these elements will be discussed in this section; others are discussed in other parts of the report.

Transboundary organisations such as joint bodies play an essential role in accomplishing a proper institutional framework. Moreover, it should be recognised that building confidence and organisational skills is a long-term process for transboundary organisations, and that some results may take decades to achieve. The potential for effective cooperation is increased when the institutional mechanism that is established for such cooperation, such as a river basin organisation, is functioning (Wouters, 2013).

Generally, a joint body is appointed as the major instrument for coordination of and communication about the implementation of the transboundary strategy. The joint bodies build on their links with the national institutions. As stated above, all cases except for the Neman have a joint body in place that supports the development and implementation of the strategy. The COMESA-EAC-SADC case is complicated because there are three coordinating mechanisms: the Common Market for Eastern and Southern Africa (COMESA), the East African Community (EAC) and the Southern African Development Community (SADC). Here, the responsibility for the coordination is vested in the Tripartite COMESA-EAC-SADC reporting structure. Management of the Programme will be the responsibility of Climate Change Unit of COMESA

supported by Programme Coordination Units in EAC and SADC (SADC, 2011). This example shows that when no joint body – or in the case of COMESA-EAC-SADC no singular joint body – is in place, the responsibility for the coordination of the strategy needs to be entrusted to one institution, to be agreed upon by all parties.

All reviewed cases acknowledge the importance of capacity building of institutions and stakeholders to allow them to understand the process and the mechanisms to enable them to act effectively. This also entails communication on the process to the wider public to ensure wide support of the measures.

7 INFORMATION USED/REQUIRED

7.1 Information management

Information is needed to assess the current situation and vulnerabilities to develop understanding of the possible future scenarios. It is also needed to monitor policy progress. Sharing information, including from early warning systems, between countries and sectors is essential for effective and efficient climate change adaptation. This requires riparian countries to exchange information and reach an agreement on the methodologies of data collection or to carry out joint monitoring of the waters they share upon which joint water management strategies can be built. Moreover, monitoring and observation systems should be capable of adapting to the changes in information needs that could develop in the future (J. G. Timmerman et al., 2011; UNECE, 2009). In practice, monitoring and observation systems will change over time, but usually, little consideration is given to linking the monitoring to the decision-making process (R. Giordano, et al., 2008; J. G. Timmerman, et al., 2010). Consequently, the strategy should be based on commonly accepted information. But subsequently, to ensure a flexible adaptation that takes account of the changes as they occur, an M&E system is needed. This will be discussed in Chapter 10.

Most of the strategies reviewed here build on or develop an overview of existing studies. The information is collected through literature studies (e.g. Danube and Rhine basins) or through expert knowledge (in the case of the EU strategy). The Amazon and ASEAN did not develop an assessment of vulnerability but they basically describe the direction considered necessary. Within the direction described in these strategies, a vulnerability assessment should be performed and concrete measures formulated. In the Neman basin, the available information from the countries was collected as part of the project to develop the strategy.

7.2 Impact assessment

To develop an impact assessment, there are basically two different schools of thought. One focuses on the need for accurate, high-resolution climate forecasts. According to this school of thought, scenarios and models are tools to handle the uncertainty of a changing situation by providing information on possible futures. According to the other school of thought, assessing and responding to climate change should be approached from the perspective of risk assessment and management rather than as a prediction problem, due to current limitations in modelling capabilities. The UNECE Guidance promotes the development of an impact assessment on the basis of the best

available information and concurrent development of knowledge to improve the capabilities for impact assessments (UNECE, 2009). This is an in-between position of using the information available combined with a risk assessment approach to start adapting while improving the knowledge base, which in time may enhance the adaptation strategy.

The cases studied here mostly follow this in-between position approach and build on existing studies. As a consequence, the models and scenarios used vary even within one case: some studies are detailed, while others are more indicative. Often, the Intergovernmental Panel on Climate Change(IPCC) Special Report on Emissions Scenarios (SRES) scenarios (Nakicenovic, et al., 2000) are the basis for the studies. In the Neman case, the impact assessment was performed as part of the project. In all cases where an impact assessment was performed, different models are used. The effect of using existing studies is that the impact assessments are often based on studies on the countries' sections of the river basin or specific regions, and seldom on studies on the basin as a whole. Nevertheless, by combining the studies into one strategy, the major differences between countries projections can become part of a discussion and some level of agreement can be developed.

7.3 Vulnerability assessment

Vulnerability is "the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity" (Füssel & Klein, 2006, p. 306). This definition may refer to physical, economic and social vulnerability. Vulnerability may be different for different riparian countries in a transboundary basin, even if the risks are similar (UNECE, 2009). This becomes more evident if considering the concept of social vulnerability that can be described by six key attributes, each of which implies a different approach (Downing, et al., 2006):

1. Vulnerability is the differential exposure to stresses experienced or anticipated by different exposure units.
2. Vulnerability is a dynamic process, changing on a variety of inter-linked time scales.
3. Social vulnerability is rooted in the actions and multiple attributes of human actors.
4. Social networks drive and bound vulnerability in the social, economic, political and environmental interactions.
5. Vulnerability is constructed simultaneously on more than one scale.
6. Multiple stresses are inherent in integrated vulnerability of peoples, places and systems.

With these attributes in place, concepts such as resistance and resilience become fundamental to understand vulnerability as a function of exposure (Sauri, 2008). It may be clear that vulnerability is multi-faceted, which makes harmonization of the concept throughout riparian countries even more complicated.

From the cases we learn that the strategies build on vulnerability studies. The Danube strategy explicitly states that there is currently no consistent and homogenous vulnerability assessment, neither qualitative (descriptive) nor quantitative (based on indicators), which exists for the Danube River Basin as a whole. The most comprehensive studies covering larger parts of the Danube River Basin are the European Spatial Planning Observation Network (ESPON) Climate and the ClimWatAdapt projects (ICPDR, 2013). The EU strategy builds on the vulnerability study done by the European Environment Agency (EEA, 2012). The Nile and Rhine build on existing studies. For ASEAN, COMESA-EAC-SADC and Amazon, no vulnerability assessment was performed.

8 ADAPTATION GOALS, OBJECTIVES & MEASURES

8.1 Adaptation goals and objectives

"The ultimate objective of adapting water management to natural variability and climate change is to decrease the vulnerability of ecosystems and societies" (Wilk & Wittgren, 2009, p. 7). But as the concept of vulnerability may be interpreted in different ways as discussed above, the goals and objectives may differ. Nevertheless, "at the transboundary level, common objectives and goals should be defined and major planned measures discussed" (UNECE, 2009, p. 91)

A general adaptation goal is to maintain and improve the state of an environmental resource affected by human activities. IWRM in general is a means to achieve this goal because it recognises the interdependency of all water uses and seeks to balance social, economic and environmental objectives in the management of water resources. In many cases, however, different goals are in conflict and the notion of 'integrated" in IWRM indicates that "resources management should be approached from a broad perspective taking all potential trade-offs and different scales in space and time into account" (Pahl-Wostl, 2007, p. 561). Moreover, management efforts must now also include future climatic factors as well as historical climatic conditions (Cooley & Gleick, 2011). Setting joint goals and implementing them is consequently a burdensome task.

To be effective, riparian countries need to show strong ownership of their water cooperation. Having concrete goals and sometimes long-term goals can help countries cooperate, which is also enhanced when the countries have a clear idea of the benefits from cooperating (BMZ, 2006). Moreover, the stated goals need to be measurable to be able to monitor and evaluate the effects of cooperation (Vollmer, et al., 2009).

The general objective stated in most of the reviewed strategies is to build and/or improve resilience of the socio-economic and natural system in order to be better prepared for changing conditions as a result of climate change (Table 3). For the Danube and Rhine basins, the basic goals are to streamline climate change measures into the existing policy and management processes of the EU Water Framework Directive and the EU Floods Directive. The EU Strategy takes a step further by widening the scope of climate adaptation, where urban and agricultural adaptation form important elements. The COMESA-EAC-SADC strategy mainly focuses on improving the readiness for adaptation on various levels, but also includes agriculture, forestry and health. The COMESA-EAC-SADC strategy distinguishes between actions targeting the

global arena and the region. The Nile basin focuses on the most vulnerable ecosystems and economies, and on developing pilots in hotspots. The ASEAN strategy has a strong focus on improving information and knowledge on the issue of climate change in addition to assessing adaptation options. The Amazon Agenda mainly focuses on improving the cooperation and exchange of information, and identifies a series of activities to achieve this goal. The Neman basin finally focuses on water resources and related natural resources, industries and conditions of vital activity.

Table 3 Overview of goals and objectives in the reviewed case studies

Case study	Goals and objectives
Amazon Strategic Cooperation Agenda (ACTO 2010)	The goal is to have a permanent cooperation, an exchange and information forum guided by the principle of reducing regional asymmetries among the Member Countries through the following actions: cooperating in national processes for socio-economic progress; enabling a gradual incorporation of these vast territories into the national economies; promoting regional cooperation actions to improve the quality of life of Amazonian inhabitants; working under the principle of sustainable development and sustainable livelihoods in harmony with nature and the environment; and considering the internal laws of the Member Countries.
ASEAN Adaptation Strategy (ASEAN 2012)	Objectives: • Exchange information on research and developments in practice in the field of hydrology and agriculture regarding food security and water resources management; climate adaptation efforts in urban, rural, and coastal areas; • Strengthen ASEAN climate/meteorological/oceanographical centres and networks between these centres in order to assess climate change impacts on socio-economic development, health and environment protection, to share (regional) climate data and to strengthen climate/meteorological/oceanographical observatory systems in the ASEAN region.

Case study	Goals and objectives
	• Assess climate adaptation options and needs for the region and sub-regions such as the Brunei Darussalam-Indonesia-Malaysia-Philippines East ASEAN Growth Area (BIMP-EAGA) and Greater Mekong Sub-region (GMS). And developing ASEAN work programme to address loss and damage, and options for risk management and reduction; • Implement the action plan that encourages cooperation/collaboration with other existing regional and sub-regional institutions/initiatives, for example, Greater Mekong Sub-region initiatives, Mekong River Commission (MRC) and the Heart of Borneo initiative.
COMESA-EAC-SADC Climate Change Adaptation Strategy for the Water Sector (SADC, 2011)	Objective in the international arena: • Include Agriculture and Forestry in the Climate Change regime of UNFCCC and expand the application of mitigation measures in the land use and clean renewable energy sectors. It also aims to derive a larger share of the resources available from climate change initiatives for Africa and to support member states to access adaptation funds and other climate change financing sources and mechanisms through national investment frameworks for climate adaptation in agriculture, forestry and other land uses. Objective in the COMESA-EAC-SADC region: • Mainstream climate change, e.g. the programme concurrently addresses the Millennium Development Goal (MDG) of eliminating poverty and a key Comprehensive Africa Agriculture Development Programme (CAADP) goal of attaining food security. The strategy aims to implement climate vulnerability assessments and analysis in order to address the impacts of climate change while building economic and social resilience for present and future generations. It is also planned to apply mitigation solutions in the region with carbon trading benefits, and to establish a regional catalytic facility to support investments in national climate-smart agriculture programmes.

Case study	Goals and objectives
Danube River (ICPDR) Adaptation Strategy (ICPDR, 2013)	The goal is to provide guidance in fully integrating climate adaptation into the 2nd DRBM Plan and the 1st DFRM Plan, which are also the tools for the implementation of climate adaptation measures.
European Adaptation Strategy (EC, 2013a)	The overall goal is to contribute to a more climate-resilient Europe. This means enhancing the preparedness and capacity to respond to the impacts of climate change at local, regional, national and EU levels, developing a coherent approach and improving coordination.
Neman River adaptation framework (UNECE, 2014)	The goal is to mitigate the adverse effects of climate change on water resources and related natural resources, industries and on other vital human activities including fisheries, agriculture, health, transport, etc.
NILE - NBI Climate Change Strategy (NBI, 2013)	The goal is to build the resilience of ecosystems and economies that are most vulnerable to climate change-induced water stress in the Nile Basin countries by building key adaptive capacity and piloting adaptation in "hotspots" with technical, policy and financial interventions.
Rhine River (ICPR) adaptation strategy (unofficial)	Prepare for the future developments in the basin due to climate change, taking into account the future socio-economic situation, with active participation of all relevant sectors.

Although the goals described in the various cases are defined in an abstract way, they provide guidance for the cooperation. In defining the goals, the riparian countries find a common ground for cooperation. The differences between the strategies are rooted in differences in historical, geographical, political and cultural contexts. They reflect the priorities of the countries involved. This concurs with Raadgever and others who state that policies should be tailored to the specific interests and resources of the parties involved (Raadgever, et al., 2008).

To conclude, the goals and objectives of the strategy, should reflect the needs of the different parties involved. The regional strategies (ASEAN, COMESA-EAC-SADC and EU) focus on strengthening the capacities of the countries involved. The basin strategies focus on the issues they have identified as important for the specific basin. These strategies are both about improving the socio-economic situation as well as protecting it against the effects of climate change.

8.2 Development of measures

To be successful, any adaptation strategy should include measures covering all the steps of the adaptation chain: prevention, improving resilience, preparation, reaction and recovery. Measures for prevention and improving resilience are related both to the gradual effects of climate change and to extreme events. Preparation, response, and recovery measures are mainly relevant for extreme events such as floods and droughts. Since there is a continuum of adaptation measures, it is not always feasible to categorise certain measures as one specific type (Figure 3 and Table 4) (UNECE, 2009).

Figure 3. *The safety chain*

The adaptation strategy first concentrates on the risk control part of the chain, whereas disaster control is usually a more local issue, dealt with on the national and sub-national level. Nevertheless, cooperation can be found in, for instance, early warning (that relates to preparation) and in mutual aid in case of disasters, for instance, in the exchange of drinking water in extreme droughts or pumping capacity in case of floods.

Most of the reviewed cases aim for improving the resilience as the fundamental objective, as stated above. In the Neman strategy, flood prevention is also specifically mentioned since flood issues were at the basis for the countries' commitment in drafting a strategy. The Danube strategy identifies a series of measures that target different elements, ranging from prevention, improving resilience, preparation and response to recovery. In the other strategies, these elements also appear when examining the measures.

The measures specified in the various strategy documents include both structural (e.g. protective dams) and non-structural (e.g. regulatory and economic instruments) measures. In many cases, building or improving

infrastructure is only one of many options. Other options include, inter alia, development of policies and capacity development. An important development in defining measures is the recognition of ecosystems as an adaptation option, either in the form of restoring and preservation, or as a form of (green) infrastructural measure (Box 1).

Box 1 Ecosystem-based adaptation

There is growing recognition of the role healthy ecosystems can play in helping people adapt to climate change. Healthy ecosystems provide drinking water, habitat, shelter, food, raw materials, genetic materials, a barrier against disasters, a source of natural resources, and many other ecosystem services on which people depend for their livelihoods. As natural buffers, ecosystems are often cheaper to maintain and often more effective than physical engineering structures, such as dykes or concrete walls (Colls, et al., 2009). In developing countries where economies and livelihoods depend largely on ecosystem services, policies for adaptation to climate change should take into account the role of these services in increasing the resilience of society (Raffaele, et al., 2009).

Only in some strategies are timeframes specifically mentioned. In these cases, 2050 is often the time horizon, sometimes 2100. COMESA-EAC-SADC aims at short-term measures due to the problems that will probably be aggravated by climate change and that need to be solved at short notice.

In cases where uncertainty is addressed, the identified trends will serve to guide the strategy while acknowledging that they need to be monitored and that regular updating of the strategy is needed. In many cases, however, uncertainty as such is not explicitly addressed. Nevertheless, these cases prepare for a regular update of the strategy.

The measures specified in the different strategies reviewed are not yet detailed enough to perform a cost-benefit analysis. The measures are usually broadly described and must be detailed and implemented in the respective countries. Cost-benefit analyses are included in the strategies as an instrument for selecting the actual measures in the Danube and Rhine rivers and in the EU Strategy during the implementation phase of the strategy. The other strategies do not mention cost-benefit analysis as an instrument.

The safety chain (Figure 3) is an important tool to identify measures, because it depicts the purpose of the measure. Measures should be identified for all elements of the chain, depending on the objectives and goals of the strategy.

The level of detail of measures included in the strategy may vary from very concrete to general. This is also related to the level of cooperation, where in low cooperation, there may be a push towards defining measures on a detailed level. In general, measures that will not have a transboundary impact will be detailed at the national or sub-national level and are not included in the transboundary strategy.

More attention should be paid to measures that have or need to have a transboundary influence. One approach to this can be an agreement that a country must take measures that result in, for instance, an overall decrease of the discharge of a certain amount of water in case of flooding. This enables that country to define its own measures but still account for the transboundary effects. The strategy can then include a more general description of the measure(s), stating the effects rather than the measures. In all situations, it should be determined at what level the measures should be taken and their details should be specified. Table 4 gives an overview of possible adaptation measures in different phases of the safety chain (Figure 3).

As stated earlier, in practice in transboundary water management, both conflict and cooperation exist at the same time. This also implies that while countries commit themselves to achieving a common goal, they can at the same time have strong disagreement over the precise definition of that goal and particularly over the means of achieving it (Mirumachi & Allan, 2007). Common definition of measures and their implementation is therefore equally important as a commonly defined goal. Uncertainty can hinder reaching common agreement over measures. It appears that in such cases, searching for offering more certainty is not very helpful and could trigger other mechanisms that create an even tighter deadlock. By framing adaptation as something innovative, chances increase that progress is made (Biesbroek, et al., 2014).

Table 4 Overview of possible adaptation measures

Type of measures	Flood-prone situation	Drought-prone situation	Impaired water quality	Health effects
Prevention / improving resilience Possible measures	• Restriction of urban development in flood risk zones • Measures aiming at maintaining dam safety, afforestation and other structural measures to avoid mudflows • Construction of dykes • Changes in operation of reservoirs and lakes • Land use management • Implementation of retention areas • Improved drainage possibilities	• Reducing need for water • Water conservation measures / effective water use (industrial and other sectors' practices and technologies, recycling / reusing wastewater) • Water saving (e.g. permit systems for water users, education and awareness-raising) • Land use management • Fostering water efficient technologies and practices (e.g. irrigation) • Enlarging the availability of water (e.g. increase of reservoir capacity) • Improving the landscape water balance • Introduction of strengthening of a sustainable groundwater management strategy • Joint operation of water supply and water management networks or building of new networks	• Prevention of and cleaning up of dump sites in flood risk zones • Improved waste water treatment • Regulation of wastewater discharge • Improved drinking water intake • Safety and effectiveness of waste water systems • Isolation of dump sites in flood risk zones	• Strengthen capacity for long-term preparation and planning, especially to identify, address and remedy the underlying social and environmental determinants that increase vulnerability • Use existing systems and links to general and emergency response systems • Ensure effective communication services for use by health officials • Regular vector control and vaccination programmes

Type of measures	Flood-prone situation	Drought-prone situation	Impaired water quality	Health effects
	• Structural measures (temporary dams, building resilient housing, modifying transport infrastructure) • Migration of people away from high-risk areas	• Identification and evaluation of alternative strategic water resources (surface and groundwater) • Identification and evaluation of alternative technological solutions (desalinization; reuse of wastewater) • Increase of storage capacity (for surface and ground waters) both natural and artificial • Considering additional water supply infrastructure • Economic instruments like metering, pricing, etc. • Water reallocation mechanisms to highly valued uses • Reducing leakages in distribution network • Rainwater harvesting and storage • Reducing water demand for irrigation by changing crop mix and calendar, irrigation method • Promoting indigenous practices for sustainable water use • Importing water-intensive agricultural products (virtual water)	• Temporary wastewater storage facilities • Catchment protection (e.g. increasing protected areas)	• Public education and awareness-raising • Measures against the heat island effect through physical modification of built environment and improved housing and building standards

Type of measures	Flood-prone situation	Drought-prone situation	Impaired water quality	Health effects
Preparation Possible measures	• Flood warning (incl. early warning) • Emergency planning (incl. evacuation) • Flash-flood risks (measures taken as prevention, as the warning time is too short to react) • Flood hazard and risk mapping	• Development of drought management plan • Changing reservoir operation rules • Prioritization of water use • Restrictions for water abstraction for appointed uses • Emergency planning • Awareness-raising • Risk communication to the public • Training and exercise	• Restrictions to wastewater discharge and implementation of emergency water storage • Regular monitoring of drinking water	• Strengthen the mechanism for early warning and action • Improved disease / vector surveillance/ monitoring • Ensuring well-equipped health stations and availability of communication and transportation facilities • Developing water safety plans
Response Possible measures	• Emergency medical care • Safe drinking water distribution • Safe sanitation provision • Prioritisation and type of distribution (bottled water, plastic bags, etc.)			
Recovery Possible measures	• Clean-up activities • Rehabilitation options such as reconstruction of infrastructure • Governance aspects such as legislation on, *inter alia*, insurance, a clear policy for rehabilitation, proper institutional settings, rehabilitation plans and capacities, and information collection and dissemination. • Specially targeted projects: new infrastructures, better schools, hospitals, etc. • All kinds of financial and economic support • Special tax regimes for investments, companies, people • Insurance • Evaluation.			

Source: UNECE (2009)

8.3 Implementation of measures

One important aspect of implementing a plan or strategy is that it demands action at different scales by different actors (Woodhill, 2004). A clear implementation plan is therefore needed and much coordination is consequently anticipated. The implementation plan should be developed by the riparian countries themselves to ensure that the proper measures are included (BMZ, 2006). Also, the process of developing and implementing adaptation measures should build on learning-by-doing, that means there has to be sufficiently flexibility to enable changes when the steps taken do not lead to the desired results or if they have unexpected side-effects Next to that, it is essential that national implementation is consistent with the obligations set out in transboundary agreements and regional legislation (UNECE, 2009).

All of the reviewed strategies have an implementation plan, except for the Rhine and Neman basins. The Neman basin expects to have an implementation plan set up by the international basin commission to be installed. The Rhine draft strategy is still at a phase where the discussion focuses on the measures to be taken and implementation is not yet discussed. The cases that have an implementation plan ensure that they are incorporated in existing planning cycles, such as the Water Framework Directive (WFD) and European Floods Directive (EFD) cycles for the Danube, or in the planning cycles of the international commission. If there are programmes for implementing activities and measures in the cooperation between countries, the implementation plan should best refer to them to avoid creating new mechanisms that need their own coordination and diluting attention to implementation.

9 IMPLEMENTATION, MONITORING & EVALUATION

9.1 Implementation

As stated above, all strategies have an implementation plan, except for the Rhine and Neman basins that are still under development. To date, none of the cases has actual experience with the implementation of the strategies.

From the available literature it becomes clear that there are many different barriers to successful implementation of plans, such as economic inequity and power asymmetry between parties (Zeitoun & Mirumachi, 2008). The power asymmetry may be confronted through strategies to influence a powerful state with 'win-win' solutions, or by transforming the 'basin bully' into a basin leader (Jägerskog & Zeitoun, 2009). Other important barriers are political concerns about sharing data and information on a potentially strategic resource, technical constraints to monitoring and impact assessment, and economic pressures that divert financial resources to other national priorities, among others (Cooley & Gleick, 2011). An overview of barriers in a transboundary river basin context may include the following (Jägerskog & Zeitoun, 2009):

- a high level of inequality between riparian states (e.g. GDP per capita);
- major differences in political systems (e.g. authoritative vs. democratic);
- a strong geopolitical influence in a basin by certain states;
- differences in riparian state religious views and ethnic composition;
- a large difference between riparian states legal systems;
- differences in access to investment markets by riparian states;
- the existence of civil strife in a basin;
- different and/or low levels of in-country infrastructure;
- the absence of regional cooperative frameworks, e.g. Regional Economic Commissions or transboundary waters institutions;
- a basin that is closed i.e. with limited water resources or water quality constraints
- limited in-country capacity to manage water resources and to effectively participate in regional cooperation.

Each basin consequently has its own barriers; the above list may help to identify potential barriers and possible solutions to overcome them.

9.2 Monitoring and evaluation

Evaluation is needed to determine the relevance, efficiency, effectiveness and impact of the adaptation strategies in light of their objectives (UNECE, 2009). Monitoring and evaluation play an important role in managing complex multi-country projects and can ensure transparency regarding project progress, actions by all participating countries and results (Uitto & Duda, 2002). It is also important that continuous re-planning and reprogramming based on the results of monitoring and evaluation is institutionalised (Pahl-Wostl, et al., 2007). In addition, policies should be updated periodically to provide an opportunity to adapt objectives and measures to changing conditions and the opinions of society (Raadgever, et al., 2008).

Most strategies include an M&E mechanism either through ongoing planning processes (the Danube, Rhine and EU strategy build on, *inter alia*, the WFD and EFD processes) or included in the strategy as an activity to be implemented. ASEAN and COMESA-EAC-SADC do not mention M&E.

For the Danube and Rhine basins, and the EU strategy, the M&E process is embedded in a cycle, which accounts for a regular update and consequent flexibility, since it is able to notify changes and to respond to them. In this way, a learning-by-doing adaptation can be realized. For the other strategies, there is no specific cycle described. However, most strategies foresee an update of the strategy within four to eight years, which should account for the flexibility in responding to unexpected changes in climate and/or unexpected effects of measures.

If possible, it is recommended to include the M&E cycle in an ongoing process. In this case, the strategy should describe the necessary additions and/or modifications needed. If there is no process in place, the strategy should pay sufficient attention to defining and securing this process.

10 CONCLUSIONS & RECOMMENDATIONS

Some primary conclusions can be drawn concerning the contents of an adaptation strategy and the process towards building it. This chapter provides an overview of the main conclusions of the review and recommendations for the Mekong Adaptation Strategy and Action Plan (MASAP) that is under development.

10.1 The development process

Generally, the process of developing an adaptation strategy is based on a mandate for the transboundary institution to elaborate such a document. In the LMB, such a mandate has been given. The mandate provides the context within which the strategy is developed. Note that in the Neman case the mandate was to do a project, not to develop a strategy. The outcome of the project may nevertheless lead to a joint adaptation strategy.

Depending on the mandate and the capacity of the international institution the lead for developing the strategy lies with the international institution or one of the member countries. In the case of the Mekong, the MRC will take the lead.

When the mandate does not give clear indications on the level of detail that is expected, this should be determined at the very beginning of the process in a scoping exercise. Also it should be determined what audience should read the strategy document. This determines the size of the document. Note that always supporting documents will be needed, like a review of the vulnerability assessment and other background documents as well as a policy summary and brochures.

In most of the reviewed cases, the policy, legal and institutional framework has not been evaluated in view of the adaptation strategy. In some cases, the longer-lasting cooperation ensured that an explicit evaluation was not necessary. In many cases, it is advisable to perform such an evaluation, in order to ensure that the adaptation strategy will be implemented. In the Mekong, there is substantial experience in cooperation. Nevertheless, it is advisable to evaluate the enabling environment because the adaptation strategy may enter policy fields that are not yet in line with the cooperation perspective. The policy evaluation or analysis will also help ensure that the regional strategy will be in line and provide synergies to the national strategies.

A vulnerability assessment is usually performed by reviewing available studies, at times supplemented with studies commissioned by the international

institution. There is always a need for the riparian countries to agree on the conclusions drawn from the studies. This can be achieved by disclosing the national studies and their underlying data and information for appraisal by all country representatives and experts. This ensures that sufficient trust can be built to reach joint conclusions on the vulnerability. This may be difficult in some cases because parts of the information can be considered confidential. The MRC already has substantial information available, and the adaptation strategy can build on it. Additional information may be needed. The strategy development process should provide for the possibility of collecting additional information, the nature of which may be unknown at the start of the process. Moreover, ample time should be allocated to discuss and evaluate the information collected.

It also has to be clear where the responsibility for the implementation of measures lies, which determines the level of detail of the measures to be taken. If the international institution will also be responsible for the implementation of the measures, they will have to be described in more detail than if it were the responsibility of the riparian countries. In the latter case, emphasis should be on the measures that have a direct transboundary effect. The resulting transboundary effect should, however, be accounted for in the adaptation strategy.

The process of strategy development is carried out in close cooperation with the riparian countries. In the process, care should be taken that the strategy is sufficiently anchored in the member countries and that they are sufficiently committed to ensure that they have true ownership of the strategy. In addition, all cases have some level of stakeholder participation. Depending on the type of adaptation strategy, the stakeholders are selected. Stakeholder involvement is best obtained through workshops where the problem situation and the preliminary solutions are presented and discussed. It should be noted that such participation is only effective when the stakeholders can influence the outcomes of the process.

The length of the process of developing the strategy varies depending on the elements involved. Ideally, the process should be short to prevent emerging issues from interfering. If a great deal of information is already available, for instance, when the vulnerability assessment has largely been completed, and goals and objectives are clearly set, the process may take only a short time. However, care should be taken not to 'overrun' the decision makers and stakeholders; they should have sufficient time to digest the information and respond to it. The cases show that a two to three year period is generally needed between agreeing on the mandate and agreeing on the strategy.

The projections made in the vulnerability assessment in most of the cases run until 2050. It is recommended, however, to also include an outlook until 2100. If the projections show that the direction of change is different for

the long term (2100), the strategy should account for this and the defined measures should not be counterproductive for such long-term changes.

The strategy's integrated approach allows for a wide range of sectors to be taken into account. This will inevitably complicate the process, because otherwise, the adaptation measures will prove counterproductive for one or more sectors. In turn, adaptations should be mainstreamed in all relevant policies, which will simplify the integrated approach. Also, the concept of IWRM should be a starting point for the strategy.

The issue of looking at costs and benefits of cooperation is largely ignored in the cases studied. Costs are only included as direct costs of measures. Nevertheless, there are various ways of determining possible benefits. It is recommended to include a qualitative assessment of the benefits in the strategy.

The strategy document should describe how the strategy was developed, the mandate, the steps taken, and the stakeholders involved. This would makes the process transparent and accountable.

There is no ideal size for a strategy document, because this depends on the goals of the document and the target audience; considering the cases, an average size of 50 pages should suffice. This strategy document should also include background documents.

10.2 The content of the strategy

As stated in the previous section, an evaluation of the policy, legal and institutional framework is advised in developing a strategy. This also enables accounting for a proper link with the national strategies and for differences between different riparian strategies. In turn, the national strategies may need to be adjusted on the basis of the transboundary strategy.

The strategy has to fit in the international agreements in force as well as the national legislation of the riparian countries. The evaluation of the legal framework provides the legislative boundaries and highlights the flaws and hindrances in the legislation. The strategy can include measures for a possible amendment in legislation in light of such flaws and hindrances.

The same applies for the institutional setting. Sometimes it is difficult to identify the proper institutions at both sides of the border because the mandates of institutions often differ. The strategy should provide clarity about the way institutions in the riparian countries can communicate and cooperate in implementing the strategy. The strategy should also address the need to build the capacities of institutions and stakeholders to allow them to understand the process and the mechanisms to enable them to act effectively.

The concept of vulnerability is multi-faceted and in most of the strategies studied, there is no explicit choice about their approach towards vulnerability. Mostly, physical vulnerability is used, sometimes together with economic vulnerability. Social vulnerability is often neglected. It is recommended to explicitly choose what concept of vulnerability is used to avoid any misunderstanding. For the Mekong, social vulnerability is an important factor, where often livelihoods, although often relatively well adapted to the general physical impacts (for instance, regular flooding), are vulnerable if extreme events occur in different seasons (loss of crops) or are longer lasting, especially health.

The goals and objectives within the strategy need to be determined within the context of the mandate for the strategy. Most strategies studied focus on increasing resilience. But the other aspects in the safety chain (prevention, preparation, reaction, and recovery) may be equally important and should also be determined. Moreover, since the current water management situation needs to be improved in many basins, the disaster management should particularly be improved.

All strategies define a range of measures, both structural (for instance, protective dams) and non-structural (for instance, regulatory and economic instruments). In the Mekong basin, through its pilot projects, there is substantial experience in implementing adaptation measures. These experiences can serve as examples in developing adaptation strategies to identify suitable measures in other places and to estimate their effects. One important, emerging type of measures is the ecosystem-based adaptation that looks highly promising and should be included in the strategy as one of the options.

In most strategies, uncertainty is not explicitly addressed. It is advised to take uncertainty into account but it should not hinder adaptation. For this reason, adaptation should not be considered a defensive activity, but rather as an opportunity.

Cost-benefit analysis is mentioned in some strategies as an instrument for selecting the actual measures. It is recommended to include it as an instrument, but the limitation of this approach should also be accounted for.

The strategy should include an implementation plan or action plans, and all reviewed strategies in place already have these plans. In several cases, the implementation of the strategy is incorporated into existing planning cycles. This has huge advantages because there is no need to develop new structures to monitor and steer the implementation. It is recommended to use existing structures whenever possible.

The funding for the strategy is dependent on international funds, which is not sustainable given its timeframe. It is therefore recommended to include in the strategy the development of sustainable funding mechanisms for its implementation. The range of examples of such mechanisms allows the strategy to be more resilient.

Several barriers may be encountered when implementing the strategy, as described in this report. It is recommended to include an assessment of potential barriers and possible solutions for them in the strategy.

Finally, the strategy should include an M&E system. It should describe what should be monitored and what criteria will be used to assess the implementation, which requires a specific level of detail. In some of the strategies studied, the strategy mentioned the need for developing an M&E system and described which institution would be responsible. Other strategies give a more detailed description of the M&E system. For proper evaluation, it is also recommended to specify a period after which the strategy will be revised.

10.3 Recommendations for the Mekong Climate Change Adaptation Strategy and Action Plan (MASAP)

To make the Mekong Adaptation Strategy and Action Plan (MASAP) effective and efficient, some essential elements can be derived from this review. The process to formulate the MASAP should consider, when appropriate:

- Include an evaluation of the policy, legal and institutional framework in the development of the strategy. Such an evaluation can identify mismatches between the national and transboundary level, which the strategy can subsequently address.
- Ensure that there is a common understanding and appreciation of the projected impacts and vulnerabilities. This can be achieved by ensuring information exchange and ample participation of experts and stakeholders.
- Ensure ownership of the member countries. Full participation of member countries following the CCAI stakeholder engagement framework will help achieve this.
- Sufficient time should be allocated for participation such as in workshops and meetings. It should be noted that workshops and meetings require sufficient preparation and participants require feedback on the outcomes and further process after the meeting.
- Many measures will be taken at the local level, where organized public participation can help the implementation. Depending on the level of detail of the strategy, this should be dealt with either within the strategy development process or in the implementation process. In the latter

case, the participation process should be part of the implementation plan.

- Consideration of joint benefits can greatly improve the effectiveness of the strategy and should therefore be included.
- In the less populated parts of the basin, in particular, ecosystem-based adaptation measures can be very cost-effective, which can also provide solutions for the more populated areas.
- The adaptation strategy should also look at innovation potential of measures. Adaptation should not be considered a mere defence mechanism, but should be approached as an opportunity for more sustainable socio-economic and ecological development.
- The strategy should be regularly reviewed, ideally every 5-10 years, depending on the goals of the strategy and the time required for implementation the short- and medium-term measures.

References:

ACTO. (2010). Amazonian Strategic Cooperation Agenda (Approved at the X Meeting of the TCA's Ministers of Foreign Affairs). Brasilia: Author.

ASEAN. (2010, April 9). *ASEAN leaders' statement on joint response to climate change*. Ha Noi: ASEAN Secretariat Retrieved from http://www.asean.org/news/item/asean-leaders-statement-on-joint-response-to-climate-change.

ASEAN. (2011, November 17). *ASEAN leaders' statement on climate change to the 17th Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) and the 7th session of the Conference of Parties serving as the Meeting of Parties to the Kyoto Protocol*. Bali: ASEAN Secretariat Retrieved from http://www.asean.org/archive/documents/19th%20summit/ASEAN_Leaders'_Statement_on_Climate_Change.pdf.

ASEAN. (2013, March 27). *ASEAN action plan on joint response to climate change*. Phnom Penh: ASEAN Secretariat Retrieved from http://environment.asean.org/wp-content/uploads/2014/02/ANNEX-8-Lead-Countries-for-ASEAN-Action-Plan-on-Joint-Response-to-Climate-Change-27-March-2013.pdf.

Biesbroek, G. R., Termeer, C. J. A. M., Klostermann, J. E. M., & Kabat, P. (2014). Rethinking barriers to adaptation: Mechanism-based explanation of impasses in the governance of an innovative adaptation measure. *Global Environmental Change, 26*, 108-118. doi: 10.1016/j.gloenvcha.2014.04.004

BMZ. (2006). *Transboundary water cooperation: A BMZ position paper*. Bonn: Author.

Colls, A., Ash, N., & Ikkala, N. (2009). Ecosystem-based adaptation: A natural response to climate change. Gland: International Union for Conservation of Nature and Natural Resources.

Cooley, H., & Gleick, P. H. (2011). Climate-proofing transboundary water agreements. *Hydrological Sciences Journal, 56*(4), 711-718. doi: 10.1080/02626667.2011.576651

Dieperink, C. (2011). International water negotiations under asymmetry: Lessons from the Rhine chlorides dispute settlement (1931–2004). *International Environmental Agreements: Politics, Law and Economics, 11*(2), 139-157. doi: 10.1007/s10784-010-9129-3

Downing, T. E., Aerts, J., Soussan, J., Barthelemy, O., Bharwani, S., Ionescu, C., . . . Ziervogel, G. (2006). Integrating social vulnerability into water management *NeWater Working Paper No. 5: New approaches to adaptive water management under uncertainty*. Oxford: Stockholm Environment Institute.

EC. (2013a). An EU strategy on adaptation to climate change (Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Region). Brussels: Author.

EC. (2013b). Impact assessment: Part 1 (Commission staff working document). Brussels: Author.

EC. (2013c). Impact Assessment: Part 2 (Commission staff working document). Brussels: Author.

EEA. (2012). Climate change, impacts and vulnerability in Europe 2012: An indicator-based report *EEA Report No 12/2012*. Copenhagen, K: Author.

Füssel, H.-M., & Klein, R. J. T. (2006). Climate change vulnerability assessments: An evolution of conceptual thinking. *Climatic Change, 75*(3), 301–329. doi: 10.1007/s10584-006-0329-3

Giordano, M., Drieschova, A., Duncan, J., Sayama, Y., De Stefano, L., & Wolf, A. (2013). A review of the evolution and state of transboundary freshwater treaties. *International Environmental Agreements: Politics, Law and Economics, 14*(3), 245-264. doi: 10.1007/s10784-013-9211-8

Giordano, R., Uricchio, V. F., & Vurro, M. (2008). Monitoring information systems to support integrated decision-making. In J. G. Timmerman, C. Pahl-Wostl & J. Möltgen (Eds.), *The adaptiveness of IWRM: Analysing European IWRM research* (pp. 113 - 128). London: IWA Publishing.

Gooch, G. D., & Huitema, D. (2007). Participation in water management: Theory and practice. In J. G. Timmerman, C. Pahl-Wostl & J. Möltgen (Eds.), *The adaptiveness of IWRM: analysing European IWRM research* (pp. 27-44). London: IWA Publishing.

Görgen, K., Beersma, J., Brahmer, G., Buiteveld, H., Carambia, M., de Keizer, O., . . . Volken, D. (2010). Assessment of climate change impacts on discharge in the River Rhine basin: Results of the RheinBlick2050 Project (CHR report I-23). Lelystad: International Commission for the Hydrology of the Rhine Basin.

GWP-INBO. (2009). *A handbook for integrated water resources management in basins*. Sweden: Author.

GWP-TAC. (2000). Integrated water resources management *TAC Background Paper No. 4*. Stockholm: Global Water Partnership.

Hooper, B. P., & Lloyd, G. J. (2011). Report on IWRM in transboundary basins. Hørsholm: UNEP-DHI Centre for Water and Environment.

ICPDR. (2010, February 16). *Danube Declaration (Adopted at the Ministerial Meeting, February 16, 2010)*. Vienna: ICPDR Secretariat Retrieved from http://www.icpdr.org/main/sites/default/files/Ministerial%20Declaration%20FINAL.pdf.

ICPDR. (2013). *ICPDR Strategy on Adaptation to Climate Change* Retrieved from www.icpdr.org/main/sites/default/files/nodes/documents/icpdr_climate-adaptation-strategy.pdf

ICPR. (2009). *Action plan on floods 1995-2005: Action targets, implementation and results*. Koblenz: Author.

ICPR. (2013, October 28). *15th Conference of Rhine Ministers: Communiqué of Ministers*. Basel: Author Retrieved from http://www.iksr.org/fileadmin/user_upload/Dokumente_en/Communique_/2013_EN_Ministerial_Declaration.pdf.

Jägerskog, A., & Zeitoun, M. (2009). Getting transboundary water right: Theory and practice for effective cooperation *Report No. 25*. Stockholm: Stockholm International Water Institute.

Jaspers, F. G. W. (2003). Institutional arrangements for integrated river basin management. *Water Policy, 5*, 77-90.

Jønch-Clausen, T. (2004). *Integrated water resources management (IWRM) and water efficiency plans by 2005: Why, what and how?* Sweden: Global Water Partnership.

Kok, M. T. J., & de Coninck, H. C. (2007). Widening the scope of policies to address climate change: Directions for mainstreaming. *Environmental Science & Policy, 10*(7–8), 587-599. doi: 10.1016/j.envsci.2007.07.003

Mirumachi, N., & Allan, J. A. (2007). Revisiting transboundary water governance: Power, conflict cooperation and the political economy. *Proceedings from CAIWA international conference on adaptive and integrated water management: Coping with scarcity*, November 12–15, 2007, Basel, Switzerland.

Mostert, E. (2003). Conflict and co-operation in international freshwater management: A global review. *International Journal of River Basin Management, 1*(3), 267-278. doi: 10.1080/15715124.2003.9635212

MRC. (1995). *Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin*. Chiang Rai: Author.

MRC. (2011). *Climate Change and Adaptation Initiative: 2011-2015 Programme Document*. Vientiane: Author.

Nakicenovic, N., Alcamo, J., Davis, G., de Vries, B., Fenhann, J., Gaffin, S., Dadi, Z. (Eds.). (2000). *Emissions Scenarios*. Cambridge: Cambridge University Press.

NBI. (2013). *Climate Change Strategy*. Entebbe: Author.

OECD. (2014). *Water governance in the Netherlands: Fit for the future?, OECD studies on water*. Hague: OECD Publishing.

OSU. (2012, July). *International River Basin Register*. Corvallis: Author Retrieved from http://www.transboundarywaters.orst.edu/database/register/internationalriverbasinregister.html.

Pahl-Wostl, C. (2007). The implications of complexity for integrated resources management. *Environmental Modelling & Software, 22*(5), 561-569. doi: 10.1016/j.envsoft.2005.12.024

Pahl-Wostl, C., Sendzimir, J., Jeffrey, P., Aerts, J., Berkamp, G., & Cross, K. (2007). Managing change toward adaptive water management through social learning. *Ecology and Society, 12*(2), 30 http://www.ecologyandsociety.org/vol12/iss2/art30/

Petersen-Perlman, J. D., Veilleux, J. C., Zentner, M., & Wolf, A. T. (2012). Case studies on water security: Analysis of system complexity and the role of institutions. *Journal of Contemporary Water Research & Education, 149*(1), 4-12.

Prasch, M., Koch, F., Weidinger, R., & Mauser, W. (2012). Danube study: Climate change adaptation (Final report). Ludwig-Maximilians-University Munich, Department of Geography.

Raadgever, G. T., Mostert, E., Kranz, N., Interwies, E., & Timmerman, J. G. (2008). Adaptive management of transboundary river basins: Analysis of transboundary regimes from a normative perspective. *Ecology and Society, 13*(1), 14 http://www.ecologyandsociety.org/vol13/iss1/art14/

Raffaele, V., Bruno, L., Celia, M., & Pablo, I. (2009). Ecosystem-based adaptation to climate change: What role for policy-makers, society and scientists. *Mitigation and Adaptation Strategies for Global Change, 14*(8), 691-696. doi: 10.1007/s11027-009-9193-6

Ridder, D., & Pahl-Wostl, C. (2005). Participatory integrated assessment in local level planning. *Regional Environmental Change, 5*(4), 188-196. doi: 10.1007/s10113-004-0089-4

Ruth, V., Reza, A., Matt, H., Jan, L., Charlotte, v. d. S., & Wirkus, L. (2009). Institutional capacity development in transboundary water management *Insight paper from Third World Water Development Report*. Bonn: United Nations University, UN-Water Decade Programme on Capacity Development (UNW-DPC).

SADC. (2011). Programme on climate change adaptation and mitigation in the eastern and southern (COMESA-EAC-SADC) region. Gaborone: Author Retrieved from http://www.sadc.int/files/9613/5293/3510/COMESA-EAC-SADC_Climate_Change_Programme_2011.pdf.

Sadoff, C. W., & Grey, D. (2002). Beyond the river: The benefits of cooperation on international rivers. *Water Policy, 4*(5), 389-403. doi: 10.1016/S1366-7017(02)00035-1

Sauri, D. (2008). Vulnerability and exposure to shocks and stresses in river basins: A review of EU research and some avenues for the future. In J. G. Timmerman, C. Pahl-Wostl & J. Möltgen (Eds.), *The adaptiveness of IWRM: Analysing European IWRM research* (pp. 75-88). London: IWA Publishing.

Schmeier, S. (2010). Governing international watercourses - Perspectives from different disciplines: A comprehensive literature review *Working Paper No. 53*. Berlin: Hertie School of Governance, Berlin Graduate School for Transportational Studies.

Shire, Y., Greg, F., Mark, G., Meredith, G., Kelli, L., Kerstin, S., & T., W. A. (2004). Geography of international water conflict and cooperation: Data sets and applications. *Water Resources Research, 40*(5), 1-12. doi: 10.1029/2003WR002530

SmoFA. (2001). Transboundary water management as an international public good *Study 2001: 1*. Stockholm: Author.

Swart, R., & Raes, F. (2007). Making integration of adaptation and mitigation work: Mainstreaming into sustainable development policies? *Climate Policy, 7*(4), 288-303. doi: 10.1080/14693062.2007.9685657

Timmerman, J. G. (2005). The need for participatory processes and its implications for water management information. *Regional Environmental Change, 5*(4), 162-163. doi: 10.1007/s10113-004-0090-y

Timmerman, J. G., Beinat, E., Termeer, C. J. A. M., & Cofino, W. P. (2010). Analyzing the data-rich-but-information-poor syndrome in Dutch water management in historical perspective. *Environmental Management, 45*(5), 1231-1242. doi: 10.1007/s00267-010-9459-5

Timmerman, J. G., Koeppel, S., Bernardini, F., & Buntsma, J. J. (2011). Adaptation to climate change: Challenges for transboundary water management. In W. L. Filho (Ed.), *The economic, social and political elements of climate change, climate change management* (pp. 523-541): Springer-Verlag Berlin Heidelberg.

Uitto, J. I., & Duda, A. M. (2002). Management of transboundary water resources: Lessons from international cooperation for conflict prevention. *Geographical Journal, 168*(4), 365-378. doi: 10.1111/j.0016-7398.2002.00062.x

UN-Water. (2013). Water cooperation in action: Approaches, tools and processes *UN-Water Decade Programme on Advocacy and Communication (UNW-DPAC)*. Zaragoza: UN-Documentation Centre on Water and Sanitation.

UN. (2014). *UN Watercourses Convention: The legal architecture for transboundary waters*. Scotland: UN Watercourses Convention - Online User's Guide Retrieved from http://www.unwatercoursesconvention.org/importance/the-legal-architecture-for-transboundary-waters/.

UNDP-UNEP. (2011). Mainstreaming climate change adaptation into development planning: A guide for practitioners *Environment for the MDGs*: UNDP-UNEP Poverty-Environment Facility.

UNECE. (2009). *Guidance on water and adaptation to climate change*. Geneva: United Nations.

UNECE. (2014). Neman River Basin strategy of adaptation to climate change (Draft): United Nations European Commission for Europe (UNECE), Environment and Security Initiative (ENVSEC), & United Nations Development Program (UNDP).

Wilk, J., & Wittgren, H. B. (2009). Adapting water management to climate change *Swedish Water House Policy Brief Nr. 7*. Trosa: Swedish Water House.

Wolf, A. T. (2009). A long term view of water and international security. *Journal of Contemporary Water Research & Education, 142*(1), 67-75. doi: 10.1111/j.1936-704X.2009.00056.x

Woodhill, A. J. (2004). Dialogue and transboundary water resources management: Towards a framework for facilitating social learning. In J. G. Timmerman & S. Langaas (Eds.), *Environmental information in European transboundary water management* (pp. 44-59). London: IWA Publishing.

Wouters, P. (2013). International law: Facilitating transboundary water cooperation *TAC Background Papers No. 17*. Stockholm: Global Water Partnership.

Mark, Z., & Naho, M. (2008). Transboundary water interaction I: Reconsidering conflict and cooperation. *International Environmental Agreements: Politics, Law and Economics, 8*(4), 297-316. doi: 10.1007/s10784-008-9083-5

Zevenbergen, C., Rijkea, J., van Herk, S., Ludy, J., & Ashley, R. (2013). Room for the river: International relevance. *Water Governance, 2*, 24-31.

Annex 1. Overview of basins with a transboundary adaptation strategy

Table A1.1 Asia: International River Basin register (updated August 2012)

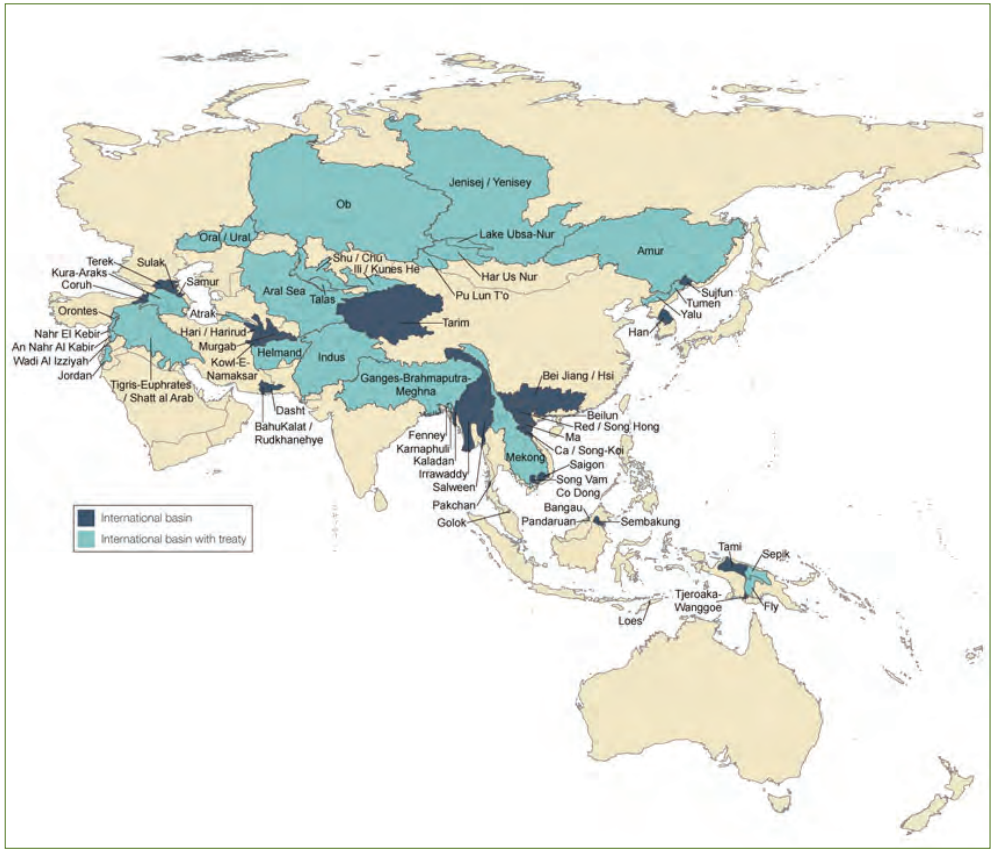
No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Adaptation strategy
1	Bei Jiang/Hsi	417,800	China	407,900	98	No
			Viet Nam	9,800	2	
2	Ca/Song Koi	31,000	Viet Nam	20,100	65	No
			Lao, People's Democratic Republic of	10,900	35	
3	Fenney	2,800	India	1,800	66	No
			Bangladesh	1,000	34	
4	Ganges-Brahmaputra-Meghna	1,634,900	India	948,400	62	No
			China	321,300	19.65	
			Nepal	147,400	9	
			Bangladesh	107,100	7	
			India, claimed by China	67,100	4.11	
			Bhutan	39,900	2.44	
			India control, claimed by China	1,200	0.07	
			Myanmar (Burma)	80	<1	

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Adaptation strategy
5	Golok	1,800	Thailand	1,000	56	No
			Malaysia	800	44	
6	Indus (25, 26)	1,138,800	Pakistan	597,700	52.48	No
			India	381,600	34	
			China	76,200	8	
			Afghanistan	72,100	6	
			Chinese control, claimed by India	9,600	0.84	
			Indian control, claimed by China	1,600	0.14	
			Nepal	10	<1	
7	Irrawaddy	404,200	Myanmar (Burma)	368,600	91.2	No
			China	18,500	5	
			India	14,100	4	
			India, claimed by China	1,200	0.3	
8	Kaladan	30,500	Myanmar (Burma)	22,900	76	No
			India	7,300	24	
9	Karnaphuli	12,500	Bangladesh	7,400	59	No
			India	5,100	41	
			Myanmar (Burma)	10	<1	
10	Ma	30,300	Viet Nam	17,100	56	No
			Lao, People's Democratic Republic of	13,200	44	

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Adaptation strategy
11	Pakchan	3,900	Myanmar (Burma) Thailand	1,900 1,800	51 49	No
12	Red/Song Hong	157,100	China Viet Nam Lao, People's Democratic Republic of	84,500 71,500 1,200	54 46 1	No
13	Salween	244,000	China Myanmar (Burma) Thailand	127,900 107,000 9,100	52 44 4	No
14	Sembakung	15,300	Indonesia Malaysia	8,100 7,200	53 47	No
15	Sepik	73,400	Papua New Guinea Indonesia	7,100 2,300	97 3	No
16	Song Vam Co Dong	15,300	Viet Nam Cambodia (Kampuchea)	7,800 7,500	51 49	No

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Adaptation strategy
17	Tjeroaka-Wanggoe	6,600	Indonesia Papua New Guinea	4,000 2,500	62 38	No
18	Tumen	29,100	China Korea, Democratic People's Republic of (North) Russian Federation	20,300 8,300 500	70 29 2	No
19	Yalu	50,900	China Korea, Democratic People's Republic of (North)	26,800 23,800	53 47	No

Source: OSU (2012)



Map 1. *International River Basins of Asia (UN, 2014)*

Table A1.2 | Africa: International River Basin register (updated August 2012)

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Adaptation strategy
1	Akpa	4,860	Cameroon	3,020	62	No	No
			Nigeria	1,840	38		
2	Atui	31,710	Mauritania	20,480	65	No	No
			Western Sahara	11,230	35		
3	Awash	154,360	Ethiopia	143,080	93	No	No
			Djibouti	11,020	7		
			Somalia	260	<1		
4	Baraka	66,180	Eritrea	41,460	63	No	No
			Sudan	24,720	37		
5	Benito/ Ntem	44,850	Cameroon	18,840	42	No	No
			Equatorial Guinea	15,280	34		
			Gabon	10,730	24		
6	Bia	10,860	Ghana	6,400	59	No	No
			Côte d'Ivoire	4,460	41		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Adaptation strategy
7	Buzi	27,730	Mozambique	24,580	89	No	No
			Zimbabwe	3,150	11		
8	Cavally	30,380	Côte d'Ivoire	16,600	55	No	No
			Liberia	12,510	41		
			Guinea	1,270	4		
9	Cestos	14,920	Liberia	12,610	85	No	No
			Côte d'Ivoire	2,290	15		
			Guinea	20	<1		
10	Chiloango	11,590	Congo, Democratic Republic of the (Kinshasa)	7,500	65	No	No
			Angola	3,760	32		
			Congo, Republic of the (Brazzaville)	330	3		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Adaptation strategy
11	Congo/ Zaire	3,674,850	Congo, Democratic Republic of the (Kinshasa)	2,229,860	62		No
			Central African Republic	399,420	11		
			Angola	288,850	8		
			Congo, Republic of the (Brazzaville)	246,620	7		
			Zambia	175,290	5		
			Tanzania, United Republic of	166,010	5		
			Cameroon	84,680	2		
			Burundi	14,330	<1		
			Rwanda	4,510	<1		
			Sudan	1,590	<1		
			Gabon	440	<1		
			Malawi	150	<1		
			Uganda	100	<1		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Adaptation strategy
12	Corubal	23,880	Guinea	17,400	73		No
			Guinea-Bissau	6,480	27		
13	Cross	52,430	Nigeria	40,010	76	No	No
			Cameroon	12,420	24		
14	Cuvelai/ Etosha	166,650	Namibia	113,580	68	No	No
			Angola	53,370	32		
15	Daoura	34,450	Morocco	18,140	53	No	No
			Algeria	16,310	47		
16	Dra	96,250	Morocco	75,700	79	No	No
			Algeria	20,550	21		
17	Gambia	69,540	Senegal	50,510	73		Only NAPA
			Guinea	13,120	19		
			Gambia	5,910	9		
18	Gash	39,900	Eritrea	21,370	54		No
			Sudan	9,550	24		
			Ethiopia	8,980	23		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Adaptation strategy
19	Geba	12,800	Guinea-Bissau	8,560	67	No	No
			Senegal	4,090	32		
			Guinea	50	<1		
20	Great Scarcies	12,030	Guinea	8,990	75		No
			Sierra Leone	3,040	25		
21	Guir	78,840	Algeria	61,110	78	No	No
			Morocco	17,730	22		
22	Incomati	46,650	South Africa	29,070	62		National strategies, ongoing work towards basin flood management strategy and adaptation strategy
			Mozambique	14,620	31		
			Swaziland	2,960	6		
23	Juba-Shibeli	799,780	Ethiopia	365,610	46		No
			Somalia	219,990	28		
			Kenya	214,180	27		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Adaptation strategy
24	Komoe	77,900	Côte d'Ivoire	58,120	75	No	No
			Burkina Faso	16,880	22		
			Ghana	2,270	3		
			Mali	630	1		
25	Kunene	109,640	Angola	95,070	87		No
			Namibia	14,570	13		
26	Lake Chad	2,380,480	Chad	1,088,150	46		No
			Niger	671,810	28		
			Central African Republic	217,380	9		
			Nigeria	179,480	8		
			Algeria	89,680	4		
			Sudan	82,860	3		
			Cameroon	46,490	2		
			Libya	4,630	<1		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Adaptation strategy
27	Lake Natron	55,190	Tanzania, United Republic of	36,950	67	No	No
			Kenya	18,240	33		
28	Lake Turkana	206,210	Ethiopia	113,000	55		No
			Kenya	89,250	43		
			Uganda	2,460	1		
			Sudan	1,500	1		
29	Limpopo	413,560	South Africa	183,050	44		Farmers' adaptation strategy
			Mozambique	86,970	21		
			Botswana	81,070	20		
			Zimbabwe	62,470	15		
30	Little Scarcies	18,800	Sierra Leone	12,970	69	No	No
			Guinea	5,730	31		
31	Loffa	11,350	Liberia	10,040	88	No	No
			Guinea	1,310	12		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Adaptation strategy
32	Lotagipi Swamp	38,680	Kenya	20,270	52	No	No
			Sudan	13,170	34		
			Ethiopia	3,250	8		
			Uganda	1,990	5		
33	Mana-Morro	6,870	Liberia	5,730	83	No	No
			Sierra Leone	1,140	17		
34	Maputo	30,600	South Africa	18,390	60		Assessment work completed
			Swaziland	10,670	35		
			Mozambique	1,540	5		
35	Mbe	6,940	Gabon	6,450	93	No	No
			Equatorial Guinea	500	7		
36	Medjerda	23,150	Tunisia	15,450	67	No	No
			Algeria	7,700	33		
37	Moa	22,500	Sierra Leone	10,700	48		No
			Guinea	8,850	39		
			Liberia	2,950	13		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Adaptation strategy
38	Mono	23,270	Togo	22,100	95	No	No
			Benin	1,170	5		
39	Niger	2,105,190	Nigeria	559,370	27		Strategic Development Action Plan not finalized
			Mali	538,600	25		
			Niger	496,560	24		
			Algeria	160,930	8		
			Guinea	95,420	5		
			Cameroon	87,650	4		
			Burkina Faso	82,320	4		
			Benin	45,040	2		
			Côte d'Ivoire	22,850	1		
			Chad	16,450	1		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Adaptation strategy
40	Nile	3,020,100	Sudan	1,921,860	64		Nile Basin Initiative adaptation strategy
			Ethiopia	354,890	12		
			Egypt	276,570	9		
			Uganda	237,520	8		
			Tanzania, United Republic of	119,400	4		
			Kenya	50,690	2		
			Congo, Democratic Republic of the (Kinshasa)	21,100	1		
			Rwanda	20,630	1		
			Burundi	12,850	<1		
			Eritrea	3,560	<1		
			Central African Republic	1,030	<1		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Adaptation strategy
41	Nyanga	12,260	Gabon	11,460	93	No	No
			Congo, Republic of the (Brazzaville)	800	7		
42	Ogooue	219,470	Gabon	188,500	85	No	No
			Congo, Republic of the (Brazzaville)	26,440	12		
			Cameroon	5,220	2		
			Equatorial Guinea	1,980	1		
43	Okavango	705,600	Botswana	357,200	51		River Basin Water Audit performed, focusing on agriculture
			Namibia	175,600	25		
			Angola	150,100	21		
			Zimbabwe	22,700	3		

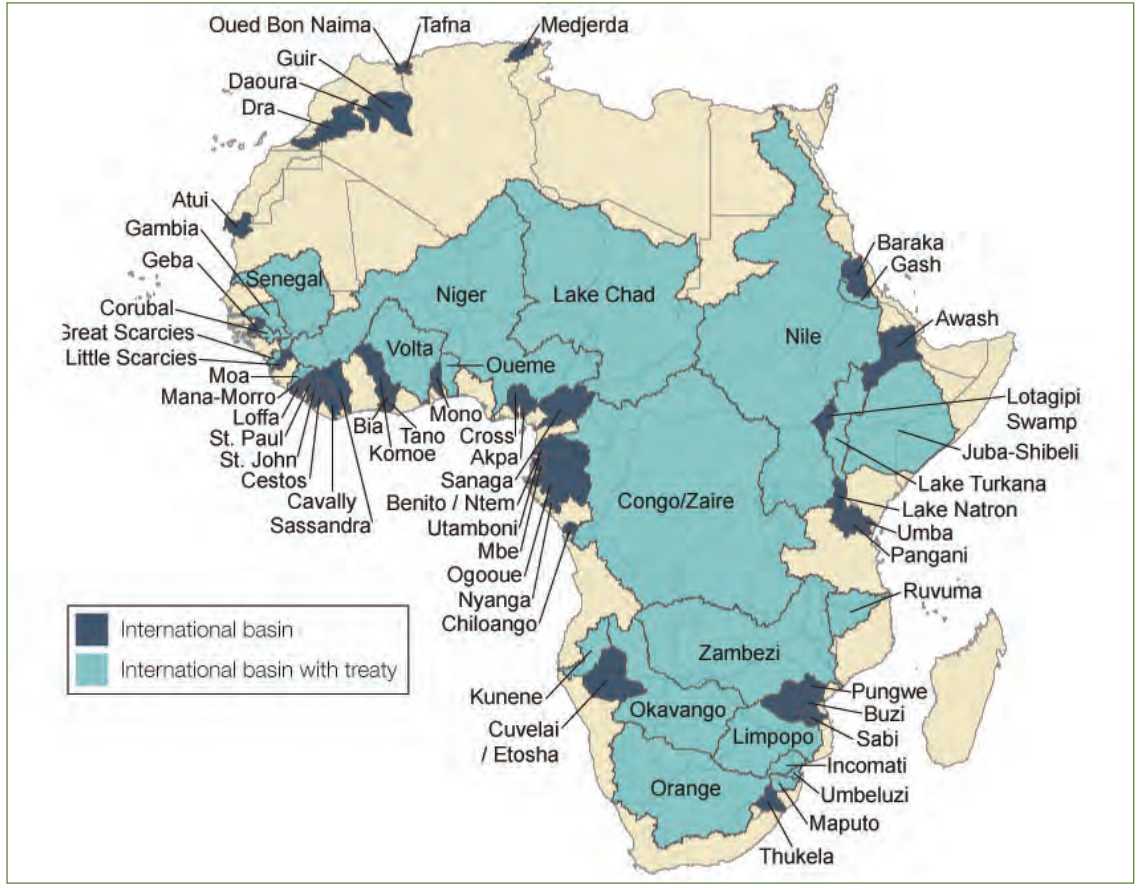
No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Adaptation strategy
44	Orange	934,050	South Africa	563,240	60		Consolidating an Integrated Water Resources Management (IWRM) Plan for the Basin
			Namibia	229,530	25		
			Botswana	121,340	13		
			Lesotho	19,940	2		
45	Oued Bon Naima	500	Morocco	330	63	No	No
			Algeria	190	37		
46	Oueme	59,140	Benin	49,040	83		No
			Nigeria	9,700	16		
			Togo	400	1		
47	Ruvuma	151,240	Mozambique	98,630	65		No
			Tanzania, United Republic of	52,170	34		
			Malawi	440	<1		
48	Sabi	115,470	Zimbabwe	85,280	74	No	No
			Mozambique	30,190	26		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Adaptation strategy
49	Sassandra	67,730	Côted'Ivoire	59,430	88	No	No
			Guinea	8,300	12		
50	Senegal	434,520	Mauritania	218,430	50		Water management programme
			Mali	150,370	35		
			Senegal	35,060	8		
			Guinea	30,660	7		
51	St. John (Africa)	15,600	Liberia	12,840	83	No	No
			Guinea	2,620	17		
52	St. Paul	21,100	Liberia	11,700	55	No	No
			Guinea	9,400	45		
53	Tafna	9,430	Algeria	7,030	75	No	No
			Morocco	2,400	25		
54	Tano	15,380	Ghana	13,700	89	No	No
			Côte d'Ivoire	1,680	11		
55	Umba	8,200	Tanzania, United Republic of	6,800	83	No	No
			Kenya	1,400	17		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Adaptation strategy
56	Umbeluzi	10,720	Mozambique	7,220	67		No
			Swaziland	3,480	32		
			South Africa	20	<1		
57	Utamboni	7,580	Gabon	4,480	59	No	No
			Equatorial Guinea	3,100	41		
58	Volta	411,200	Burkina Faso	173,140	42		No
			Ghana	165,100	40		
			Togo	25,850	6		
			Mali	18,750	5		
			Benin	15,000	4		
			Côte d'Ivoire	13,360	3		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Adaptation strategy
59	Zambezi	1,353,200	Zambia	574,770	42		Integrated Water Resources Management Strategy and Implementation Plan 2008
			Angola	253,670	18		
			Zimbabwe	214,540	16		
			Mozambique	162,980	12		
			Malawi	109,980	8		
			Tanzania, United Republic of	27,240	2		
			Botswana	18,720	1		
			Namibia	17,100	1		
			Congo, Democratic Republic of the (Kinshasa)	1,200	<1		

Source: OSU (2012)



Map 2. *International River Basins of Africa (UN, 2014)*

Table A1.3 | Europe: International River Basin register (updated August 2012)

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
1	Bann	5,600	United Kingdom	5,400	97	No	No
			Ireland	200	3		
2	Barta	1,800	Latvia	1,100	62	No	No
			Lithuania	700	38		
3	Bidasoa	500	Spain	500	87		No
			France	60	13		
4	Castletown	400	United Kingdom	300	83	No	No
			Ireland	90	17		
5	Danube	790,100	Romania	228,500	29		Yes
			Hungary	92,800	12		
			Austria	81,600	10		
			Yugoslavia (Serbiaand Montenegro)	81,500	10		
			Germany	59,000	7		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
			Slovakia	45,600	6		
			Bulgaria	40,900	5		
			Bosnia and Herzegovina	38,200	4.83		
			Croatia	35,900	5		
			Ukraine	29,600	4		
			Czech Republic	20,500	3		
			Slovenia	17,200	2		
			Moldova	13,900	2		
			Switzerland	2,500	0.32		
			Italy	1,200	<1		
			Poland	700	<1		
			Albania	200	<1		
6	Daugava	58,700	Belarus	28,300	48		No
			Latvia	20,200	34		
			Russian Federation	9,500	16		
			Lithuania	800	1		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
7	Dnieper	516,300	Ukraine	299,300	58		No
			Belarus	124,900	24		
			Russian Federation	92,100	18		
8	Dniester	62,000	Ukraine	46,800	75		Working towards an adaptation strategy
			Moldova	15,200	25		
			Poland	30	<1		
9	Don	425,600	Russian Federation	371,200	87		No
			Ukraine	54,300	13		
10	Douro/Duero	98,900	Spain	80,700	82		No
			Portugal	18,200	18		
11	Drin	17,900	Albania	8,100	46		No
			Yugoslavia (Serbia and Montenegro)	7,400	41		
			Macedonia	2,200	13		
12	Ebro	85,800	Spain	85,200	99		No
			Andorra	400	1		
			France	100	<1		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
13	Elancik	900	Russian Federation	700	73	No	No
			Ukraine	300	27		
14	Elbe	132,200	Germany	83,100	63		No
			Czech Republic	47,600	36		
			Austria	700	1		
			Poland	700	1		
15	Erne	4,800	Ireland	2,800	58	No	No
			United Kingdom	1,900	42		
16	Fane	200	Ireland	200	86	No	No
			United Kingdom	10	14		
17	Flurry	60	United Kingdom	50	52	No	No
			Ireland	20	48		
18	Foyle	2,900	United Kingdom	2,000	68	No	No
			Ireland	1,000	32		
19	Garonne	55,800	France	55,100	99		No
			Spain	600	1		
			Andorra	40	<1		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
20	Gauja	11,600	Latvia	10,400	90	No	No
			Estonia	1,100	10		
21	Glama	43,000	Norway	42,600	99		No
			Sweden	400	1		
22	Guadiana	67,900	Spain	54,900	81		National level only
			Portugal	13,000	19		
23	Isonzo	3,000	Slovenia	1,800	61		No
			Italy	1,200	39		
24	Jacobs	400	Norway	300	68		No
			Russian Federation	100	32		
25	Kemi	55,700	Finland	52,700	94		No
			Russian Federation	3,000	6		
			Norway	10	0.01		
26	Klaralven	51,000	Sweden	43,100	85		No
			Norway	7,900	15		
27	Kogilnik	6,100	Moldova	3,600	57	No	No
			Ukraine	2,600	43		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
28	Krka	1,300	Croatia	1,100	87		No
			Bosnia and Herzegovina	100	13		
			Yugoslavia (Serbia and Montenegro)	10	0.4		
29	Lake Prespa	9,000	Albania	8,000	88		Strategic action plan for the sustainable development of the Prespa Park (2005)
			Macedonia	800	9		
			Greece	300	3.32		
30	Lava/Pregel	8,600	Russian Federation	6,300	75		No
			Poland	2,000	25		
31	Lielupe	14,400	Latvia	9,600	66		No
			Lithuania	4,800	34		
32	Lima	2,300	Spain	1,200	52		No
			Portugal	1,100	48		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
33	Maritsa	49,600	Bulgaria	33,000	66		No
			Turkey	12,800	26		
			Greece	3,700	8		
34	Mino	15,100	Spain	14,500	96		No
			Portugal	600	4		
35	Mius	2,800	Russian Federation	1,900	70	No	No
			Ukraine	800	30		
36	Naatamo	1,000	Norway	600	59		No
			Finland	400	41		
37	Narva	53,000	Russian Federation	28,200	53		No
			Estonia	18,100	34		
			Latvia	5,900	11		
			Belarus	800	2		
38	Neman	90,300	Belarus	41,700	46		Draft strategic framework
			Lithuania	39,700	44		
			Russian Federation	4,800	5		
			Poland	3,800	4		
			Latvia	300	<1		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
39	Neretva	5,500	Bosnia and Herzegovina	5,300	97	No	No
			Croatia	200	3		
40	Nestos	10,200	Bulgaria	5,500	53		No
			Greece	4,700	47		
41	Oder/Odra	122,400	Poland	103,100	84		No
			Czech Republic	10,300	8		
			Germany	7,800	6		
			Slovakia	1,300	1		
42	Olanga	18,800	Russian Federation	16,800	89		No
			Finland	2,000	11		
43	Oulu	28,700	Finland	26,700	93		No
			Russian Federation	1,900	7		
44	Parnu	5,800	Estonia	5,800	100	No	No
			Latvia	10	<1		
45	Pasvik	16,000	Finland	12,400	77		No
			Russian Federation	2,600	17		
			Norway	1,000	6		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
46	Po	87,100	Italy	82,200	94.44		No
			Switzerland	4,300	5		
			France	500	0.54		
			Austria	90	0.1		
47	Prohladnaja	600	Russian Federation	500	77	No	No
			Poland	100	23		
48	Rezvaya	700	Turkey	500	82	No	No
			Bulgaria	200	18		
49	Rhine	172,900	Germany	97,700	57		Strategy under development
			Switzerland	24,300	14.05		
			France	23,100	13.34		
			Belgium	13,900	8		
			Netherlands	9,900	5.75		
			Luxembourg	2,500	1.46		
			Austria	1,300	1		
			Liechtenstein	200	0.09		
			Italy	70	0.04		

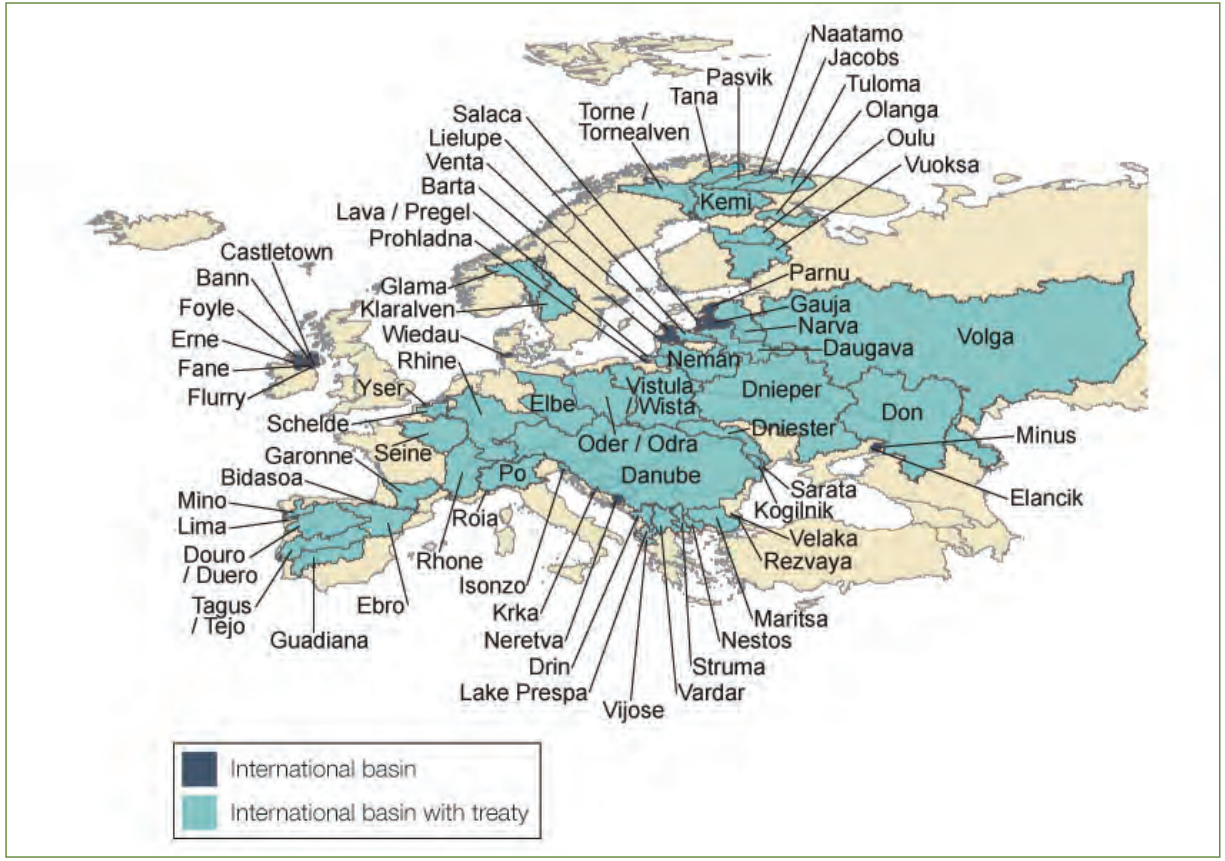
No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
50	Rhone	100,200	France	90,100	89.88		No
			Switzerland	10,100	96		
			Italy	50	0.05		
51	Roia	600	France	400	67		No
			Italy	200	33		
52	Salaca	2,100	Latvia	1,600	95	No	No
			Estonia	100	5		
53	Sarata	1,800	Ukraine	1,100	63	No	No
			Moldova	600	37		
54	Schelde	17,100	France	8,600	50		No
			Belgium	8,400	49		
			Netherlands	80	<1		
55	Seine	85,700	France	83,800	98		No
			Belgium	1,800	2		
			Luxembourg	70	<1		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
56	Struma	15,000	Bulgaria	8,600	58		No
			Greece	3,900	26		
			Macedonia	1,800	12		
			Yugoslavia (Serbia and Montenegro)	600	4		
57	Tagus/Tejo	77,900	Spain	51,400	76		No
			Portugal	26,100	33.5		
58	Tana	15,600	Norway	9,300	59		No
			Finland	6,300	41		
59	Torne/ Tornealven	37,300	Sweden	25,400	68		No
			Finland	10,400	29		
			Norway	1,500	4		
60	Tuloma	25,800	Russian Federation	23,700	92		No
			Finland	2,000	8		
61	Vardar	32,400	Macedonia	20,300	63		No
			Yugoslavia (Serbia and Montenegro)	8,200	22		
			Greece	3,900	12		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
62	Velaka	700	Bulgaria	700	94	No	No
			Turkey	30	6		
63	Venta	9,500	Latvia	6,200	65.15	No	No
			Lithuania	3,300	42		
64	Vijose	7,200	Albania	4,600	65		No
			Greece	2,500	35		
65	Vistula/Wista	194,000	Poland	169,700	87		No
			Ukraine	12,700	7		
			Belarus	9,800	5		
			Slovakia	1,900	1		
			Czech Republic	20	<1		
66	Volga	1,554,900	Russian Federation	1,551,300	100		No
			Kazakhstan	2,200	<1		
			Belarus	1,300	<1		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
67	Vuoksa	62,700	Finland	54,300	86		No
			Russian Federation	8,500	14		
68	Wiedau	1,100	Denmark	1,000	86.23		No
			Germany	200	1		
69	Yser	900	France	500	52		No
			Belgium	400	48		

Source: OSU (2012)



Map 3. *International River Basins of Europe (UN, 2014)*

Table A1.4 | North America: International River Basin register (updated August 2012)

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	
1	Alsek	28,400	Canada	26,500	93		No
			United States of America	1,800	7		
2	Artibonite	8,800	Haiti	6,600	73		No
			Dominican Republic	2,300	27		
3	Belize	11,500	Belize	7,000	62	No	No
			Guatemala	4,500	38		
4	Candelaria	12,800	Mexico	11,300	85		No
			Guatemala	1,500	15		
5	Changuinola	3,200	Panama	2,900	93	No	No
			Costa Rica	300	7		
6	Chilkat	3,800	United States of America	2,100	51		No
			Canada	1,600	49		
7	Chiriqui	1,700	Panama	1,500	96	No	No
			Costa Rica	200	4		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
8	Choluteca	7,400	Honduras	7,200	97	No	No
			Nicaragua	200	3		
9	Coatan Achute	2,000	Mexico	1,700	87		No
			Guatemala	300	13		
10	Coco/Segovia	25,400	Nicaragua	17,900	76	No	No
			Honduras	7,500	24		
11	Colorado	655,000	United States of America	644,600	98		No
			Mexico	10,400	2		
12	Columbia	668,400	United States of America	566,500	85		Climate study performed to review treaty
			Canada	101,900	15		
13	Firth	6,000	Canada	3,800	60		No
			United States of America	2,200	40		
14	Fraser	239,700	Canada	239,100	100		No
			United States of America	600	<1		
15	Goascoran	2,800	Honduras	1,500	52	No	No
			El Salvador	1,300	48		

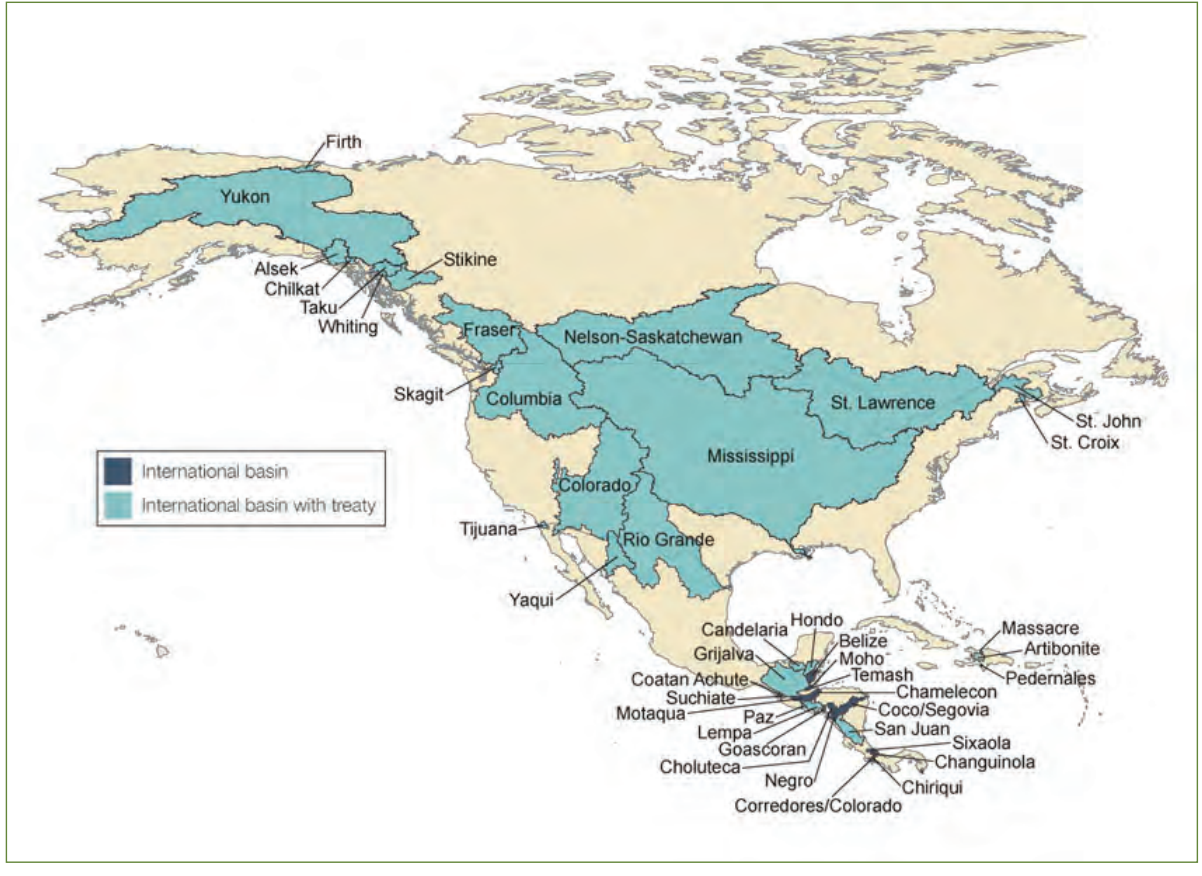
No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
16	Grijalva	126,800	Mexico	78,900	62		No
			Guatemala	47,800	38		
			Belize	20	<1		
17	Hondo	14,600	Mexico	8,900	57		No
			Guatemala	4,200	20		
			Belize	1,500	13		
18	Lempa	18,000	El Salvador	9,500	57		No
			Honduras	5,800	29		
			Guatemala	2,800	14		
19	Massacre	800	Haiti	500	54		No
			Dominican Republic	300	46		
20	Mississippi	3,226,300	United States of America	3,176,500	98		No
			Canada	49,800	2		
21	Motaqua	16,100	Guatemala	14,600	89	No	No
			Honduras	1,500	11		
22	Negro	5,800	Nicaragua	4,800	89	No	No
			Honduras	900	11		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
23	Nelson-Saskatchewan	1,109,400	Canada	952,000	86		No
			United States of America	157,400	14		
24	Paz	2,200	Guatemala	1,400	54		No
			El Salvador	800	46		
25	Pedernales	400	Haiti	200	44		No
			Dominican Republic	100	56		
26	Rio Grande (North America)	656,100	United States of America	341,800	52		Regional Framework for the Development, Management and Sustainable Use of the Water Resources of the Rio Bravo Drainage Basin
			Mexico	314,300	48		
27	San Juan	42,200	Nicaragua	30,400	70		No
			Costa Rica	11,800	30		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
28	Sarstun	2,100	Guatemala	1,800	93		No
			Belize	300	7		
29	Sixaola	2,900	Costa Rica	2,500	82		No
			Panama	300	18		
30	Skagit	8,000	United States of America	7,100	88		No
			Canada	900	12		
31	St. Croix	4,600	United States of America	3,300	65		No
			Canada	1,400	35		
32	St. John (North America)	47,700	Canada	30,300	63		No
			United States of America	17,300	37		
33	St. Lawrence	1,055,200	Canada	559,000	53		Adaptive Management in the Great Lakes - St Lawrence River System
			United States of America	496,100	47		
34	Stikine	50,900	Canada	50,000	98		No
			United States of America	900	2		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
35	Suchiate	1,600	Guatemala	1,100	74	No	No
			Mexico	500	26		
36	Taku	18,100	Canada	16,300	90		No
			United States of America	1,700	10		
37	Tijuana	4,400	Mexico	3,100	73		Tijuana River Valley Recovery Team Recovery Strategy
			United States of America	1,300	27		
38	Whiting	2,600	Canada	2,000	77		No
			United States of America	500	23		
39	Yaqui	74,700	Mexico	70,100	94		No
			United States of America	4,600	6		
40	Yukon	829,700	United States of America	496,400	60		No
			Canada	333,300	40		

Source: OSU (2012)



Map 4. *International River Basins of North America (UN, 2014)*

Table A1.5 | South America: International River Basin register (updated August 2012)

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
1	Amacuro	5,600	Venezuela, Bolivarian Republic of	4,900	87	No	No
			Guyana	700	13		
2	Amazon	5,883,400	Brazil	3,670,300	62		Amazonian Strategic Cooperation Agenda (2010)
			Peru	956,500	16.26		
			Bolivia	706,700	12		
			Colombia	367,800	6		
			Ecuador	123,800	2		
			Venezuela	40,300	1		
			Guyana	14,500	<1		
			Suriname	1,400	<1		
			French Guiana	30	<1		
3	Aviles	300	Argentina	200	89	No	No
			Chile	30	11		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
4	Aysen	13,600	Chile	13,100	96	No	No
			Argentina	500	4		
5	Baker	30,800	Chile	21,000	68	No	No
			Argentina	9,800	32		
6	Barima	2,100	Guyana	1,100	52	No	No
			Venezuela, Bolivarian Republic of	1,000	44		
7	Cancoso/ Lauca	23,500	Bolivia	20,200	86	No	No
			Chile	3,400	14		
8	Carmen Silva/ Chico	1,700	Argentina	1,000	59	No	No
			Chile	700	41		
9	Catatumbo	31,000	Colombia	19,600	63	No	No
			Venezuela, Bolivarian Republic of	11,400	37		
10	Chira	15,700	Peru	9,800	62		No
			Ecuador	5,800	38		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
11	Chuy	200	Brazil	100	75		No
			Uruguay	60	25		
12	Comau	900	Chile	900	89	No	No
			Argentina	80	11		
13	Corantijn/ Courantyne	41,800	Guyana	21,700	52	No	No
			Suriname	19,900	48		
			Brazil	80	<1		
14	Cullen	600	Chile	500	83	No	No
			Argentina	100	17		
15	Essequibo	239,500	Guyana	162,100	68	No	No
			Venezuela	52,400	22		
			Suriname	24,300	10		
			Brazil	200	<1		
16	Gallegos-Chico	11,600	Argentina	7,000	61	No	No
			Chile	4,600	39		
17	Jurado	700	Colombia	500	71	No	No
			Panama	100	29		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
18	La Plata	2,954,500	Brazil	1,379,300	47		Integrated Strategy for the Sustainable Management of the La Plata River Basin
			Argentina	817,900	28		
			Paraguay	400,100	14		
			Bolivia	245,100	8		
			Uruguay	111,600	4		
19	Lagoon Mirim	55,000	Uruguay	31,200	57		No
			Brazil	23,800	43		
20	Lake Fagnano	3,200	Argentina	2,700	85	No	No
			Chile	500	15		
21	Lake Titicaca-Poopo System	111,800	Bolivia	63,000	56		No
			Peru	48,000	43		
			Chile	800	1		
22	Maroni	65,000	Suriname	37,500	58		No
			French Guiana	27,200	42		
			Brazil	200	<1		
23	Mataje	700	Ecuador	500	71	No	No
			Colombia	200	29		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percentage of area of basin in country (%)	Treaty	Transboundary adaptation strategy
24	Mira	12,100	Colombia	6,200	52	No	No
			Ecuador	5,800	48		
25	Oiapoque/ Oyupock	23,300	French Guiana	13,700	60	No	No
			Brazil	9,500	40		
26	Orinoco	927,400	Venezuela, Bolivarian Republic of	604,500	65	No	No
			Colombia	321,700	35		
			Brazil	800	<1		
27	Palena	13,300	Chile	7,300	55	No	No
			Argentina	6,000	45		
28	Pascua	13,700	Chile	7,300	54	No	No
			Argentina	6,400	46		
29	Patia	21,300	Colombia	20,800	98	No	No
			Ecuador	500	2		
30	Puelo	8,400	Argentina	5,500	66	No	No
			Chile	2,900	34		

No.	Basin name	Total area of basin (sq. km)	Country name	Area of country in basin (sq. km)	Percent area of basin in country (%)	Treaty	Transboundary adaptation strategy
31	Rio Grande (South America)	8,000	Argentina	4,000	50	No	No
			Chile	4,000	50		
32	San Martin	700	Chile	600	88	No	No
			Argentina	80	12		
33	Seno Union/ Serrano	6,500	Chile	5,700	90	No	No
			Argentina	700	10		
34	Tumbes-Poyango	5,000	Ecuador	3,600	71		No
			Peru	1,400	29		
35	Valdivia	15,000	Chile	14,700	99	No	No
			Argentina	100	1		
36	Yelcho	11,100	Argentina	6,900	62	No	No
			Chile	4,200	38		
37	Zapaleri	2,600	Chile	1,600	58	No	No
			Argentina	500	20		
			Bolivia	500	22		
38	Zarumilla	4,300	Ecuador	3,400	79		No
			Peru	900	21		

Source: OSU (2012)

Map 5. *International River Basins of South America (UN, 2014)*

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