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for

the Global Center on Adaptation (GCA)





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Executive summary

With 145 countries worldwide having territory within a transboundary lake or river basin and 30 of them lie entirely within one or more transboundary lakes or river basins and a similar situation for transboundary groundwaters, the need for cooperation in water management is inescapable. Climate change makes the need for water climate adaptation even more urgent. This study is undertaken to identify and describe relevant conceptual frameworks and guiding principles, and to develop a roadmap that enables mainstreaming of water climate adaptation based on existing good practices as derived from five transboundary case studies. The selected case studies are the Danube Basin, the Lake Victoria Basin, the Ramotswa aquifer, the Senegal Basin, and the Volta Basin.

Two relevant frameworks have been selected for an initial analysis: the Enabling Environment framework and the OECD Principles of Water Governance. The elements from these frameworks are compared to the success factors that came out of the GCA study on mainstreaming water climate adaptation at national and urban level to identify conformities and differences. The Enabling Environment framework is subsequently complemented with elements from the OECD principles and the success factors of the GCA study.

A literature study was performed to identify potential additional factors that cater for success. The literature study comprised guidelines and reported experiences as well as scientific literature. The case studies provided an additional source of key factors. The key factors are organized within the structure of the Enabling Environment framework. After developing an overall list, the case studies were analyzed for the factors from this list that they had applied. The analysis showed that most of the case studies had applied most of the key factors and the more key factors that had been applied, the more successful the case appeared.

The full list of key factors that came out of this study thus shows to be a good indicator for successful cooperation and implementation of measures and thus provides a checklist for countries and joint bodies to improve their cooperation. It should be noted that the key factors are mainly targeting the *how* of cooperation rather than the *what*, that is described in much of the available guidelines. The checklist is thus an addition to existing guidelines.





1. Introduction and context

1.1. Context of the report

Climate change increasingly impacts society. Global warming will further intensify the global water cycle and the severity of wet and dry events (IPCC, 2021) and as a result, the impacts of climate change will be channeled primarily through the water cycle (World Bank, 2016). Water availability and water quality will become more variable and less predictable and the magnitude, development and frequency of extreme events (a.o., floods and droughts) will increase (UN-Water, 2020). Floods and droughts together have accounted for some 75% of the number of people affected by disasters over the period 2001-2020 (CRED, 2022). Adaptation plays a key role in reducing exposure and vulnerability to climate change (IPCC, 2022) with a focus on water.

Water has a central role to play when it comes to achieving the Sustainable Development Goals (SDGs). There is a close interlinkage between Goal 6 targets and every other Goal, and it is vital that these interlinkages are well understood and managed. This calls for a more integrated approach where sustainable development, disaster risk reduction and adaptation are considered together. Adaptation measures are needed that deal with climate variability and build upon existing land and water management practices to create resilience to climate change and to enhance water security and thus directly contribute to development. Improved water management is an essential component of successful climate adaptation strategies and this adaptation needs to be mainstreamed in all policies (UN-Water, 2010, 2016b, 2019).

A large part of the world's freshwater resources is contained in transboundary river basins and groundwater systems that are shared by two or more countries. There are 263 transboundary river basins and approximately 300 transboundary aquifers. 145 states have territory within transboundary lakes or river basins, and 30 countries lie entirely within them (UN-Water, 2016a). In Africa, the 48 mainland countries share 134 transboundary basins and aquifers, and 90% of Africa's surface water is in transboundary basins (GCA, 2021). Transboundary cooperation is therefore imperative to be able to attain sustainable development and avoid maladaptation.



Figure 1 Locations of the five case studies





The objective of this study is to identify and describe relevant conceptual frameworks, guiding principles, and a roadmap that enables mainstreaming of water climate adaptation based on existing good practices as derived from five transboundary case studies. The selected case studies are the Danube Basin, the Lake Victoria Basin, the Ramotswa aquifer, the Senegal Basin, and the Volta Basin (Figure 1).

1.2. Scope of the study

The scope of this study lies within the domain of four closely related frameworks, namely the Sendai Framework for Disaster Risk Reduction 2015-2030, Climate Change Adaptation, Integrated Water Resources Management, and the Sustainable Development Goals.

1.2.1. Sendai Framework for Disaster Risk Reduction

The Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR) aims at preventing the creation of disaster risk, the reduction of existing risk and the strengthening of economic, social, health and environmental resilience (UNDRR, 2015). The SFDRR outlines seven targets and four priorities for action to prevent new and reduce existing disaster risks, namely:

- a. Understanding disaster risk;
- b. Strengthening disaster risk governance to manage disaster risk;
- c. Investing in disaster reduction for resilience and;
- d. Enhancing disaster preparedness for effective response

To assess the risks as a result of potential disasters occurring in the basin, a basin-wide disaster risk assessment is needed. In a transboundary basin this includes the nature and extent of the disaster risks that have a transboundary nature or scope. Based on the concept of disaster risk (Figure 2), the disaster risk assessment starts with developing an understanding of three constituents of risks (APFM, 2007):

- The magnitude of the *hazard* expressed in terms of frequency and severity (depth, extent, duration and relative velocities);
- The exposure of human activities to disaster; and
- The *vulnerability* of the elements at risk.



Figure 2 Risk as a function of hazard, exposure and vulnerability (Source: <u>http://www.un-spider.org/risks-and-disasters/disaster-risk-management</u>)

1.2.2. Climate Change Adaptation

Climate Change Adaptation (CCA) essentially focuses on prevention and reduction of risks of disasters by reducing vulnerability and increasing resilience of societies. CCA involves top-down approaches in which assessments are made of impacts and possible adaptation actions. Decisionmakers subsequently seek to implement strategies that may improve system performance





in the face of those impacts and bottom-up approaches that focus on reducing vulnerability to past and present climate variability. Typically, this is done in the wake of an extreme event or disaster such as droughts or floods, with the expectation that building resilience to the vagrancies of the current climate will strengthen capacity to deal with change and extremes in the future (UNFCCC, 2011).

The main differences between CCA and DRR are (EEA, 2017):

- CCA mainly focuses on future and addressing uncertainty and new risks while DRR has a focus on present and addressing existing risks;
- CCA mainly addresses weather- and climate-related hazards and has a longer time-scale while DRR addresses all hazard types;
- CCA has its origin and culture in scientific theory while DRR has its origin and culture in humanitarian assistance and civil protection; and
- The main actors in CCA are in environment ministries and agencies while the main actors in DRR are in civil protection ministries and agencies.

Both CCA and DDR communities use the concept of resilience. This provides common ground upon which more coherent policies and actions might be built. The complementarity of CCA and DRR can be fostered by the development of a long-term strategic vision and local-level engagement of key actors.

1.2.3. Integrated Water Resources Management

Integrated Water Resources Management (IWRM) is a process that promotes the coordinated development and management of water, land and related resources in order to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (UNEP, n.d.). IWRM builds on the four Dublin principles (GWP-TAC, 2000):

- 1. Fresh water is a finite and vulnerable resource, essential to sustain life, development, and the environment.
- 2. Water development and management should be based on a participatory approach, involving users, planners, and policy- makers at all levels.
- 3. Women play a central part in the provision, management and safeguarding of water.
- 4. Water has an economic value in all its competing uses and should be recognized as an economic good.

IWRM requires a multidisciplinary approach that integrates water supply and sewerage systems, agriculture, industry, residential development, water works, transportation, recreation, fishing, and other activities. It also requires coordination between the sectors and adaptation of different planning and management systems within an individual basin (Moravcová et al., 2016). IWRM is recognized internationally as the standard water management approach (Dirwai et al., 2021). SDG Indicator 6.5.1 tracks the degree of IWRM implementation (see Section 1.2.4). The indicator is structured around four dimensions of IWRM, namely 1) an enabling environment in which national and subnational policies and laws outline the importance of integrated approaches to water resources management; 2) Institutions and stakeholder participation at all levels to implement plans and enforce regulations; 3) Management Instruments including data and information to allow for informed decision-making; and 4) Financing at the national and local level. In 2020, 187 reported about their progress on the implementation of IWRM with 51% reporting medium-high to very high implementation (UNEP, 2021)

Various commonalities exist between IWRM, CCA and DRR (UNECE/UNISDR, 2018):





- 1. All three propose integrative and holistic approaches, in particular, taking a systems approach (e.g. connect land and water, biophysical systems to social, economic and political systems), and acknowledging scale issues;
- 2. All three approaches stimulate and prefer preventive measures over curative measures and acknowledge the importance of healthy ecosystems as a regulatory force;
- 3. All three approaches are inclusive in nature and explicitly address the needs, interests and capacities of vulnerable groups, the poor and marginalized;
- 4. All three approaches acknowledge the need for decentralized approaches and the importance of participatory approaches, involving all stakeholders at relevant levels of interventions, including women;
- 5. All three approaches propagate good governance under the responsibility of national governments; and
- 6. All three approaches acknowledge the importance of understanding systems by means of data collection assessment and research.

The availability of clean and sufficient water is a key factor in survival and recovery. Considering the many hazards propagated through water systems, often resulting from the mismanagement of land and water resources and even from non-water related disasters, proper water management that deals with present and future risks is crucial. The importance of IWRM to CCA and DRR is hence evident, and integrating CCA and DRR strategies in IWRM plans, policies and operations is, for that reason, a logical step. Making use of the institutional frameworks that have been developed for IWRM implementation is a quick way of operationalizing parts of CCA and DRR strategies.

1.2.4. Sustainable Development Goals

The Sustainable Development Goals (SDGs) are 17 Goals, that are an urgent call for action by all countries to strive for peace and prosperity for people and the planet, now and into the future. The SDGs incorporate the abovementioned frameworks. IWRM is included in Goal 6 'Ensure availability and sustainable management of water and sanitation for all' where Target 6.5 reads 'By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate' and the Indicator 6.5.1 reads 'Degree of integrated water resources management'. DRR is included in Goal 13 'Take urgent action to combat climate change and its impacts' where Target 13.1 reads 'Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries' and the Indicator 13.1.2 reads 'Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015–2030'. CCA is also included in Goal 13 under Target 13.2 that reads 'Integrate climate change measures into national policies, strategies and planning', where the Indicator 13.2.1 reads 'Number of countries with nationally determined contributions, long-term strategies, national adaptation plans and adaptation communications, as reported to the secretariat of the United Nations Framework Convention on Climate Change' (UN DSDG, n.d.).

1.2.5. Overall scope of the study

The frameworks are designed for different purposes and are often implemented by different organizations. From the necessary holistic perspective, that is incorporated in the frameworks, they are be complementary. Where these frameworks largely indicate what needs to be done, there is also a need to describe the conditions that support the implementation. The OECD principles of good water governance (OECD, 2015) describe such conditions (see Box 1 and Box 2).





Box 1 Definition of water governance

Water governance is the set of rules, practices, and processes (formal and informal) through which decisions for the management of water resources and services are taken and implemented, stakeholders articulate their interest and decision-makers are held accountable (OECD, 2015).

This study is grounded in the four frameworks as discussed above as well as the OECD principles. It further builds on literature on transboundary cooperation and will compare findings from literature with practice on the ground from the case studies. From this, general recommendations will be formulated on how to mainstream adaptation in transboundary water management.





2. Methodology

2.1. Literature review

A literature study has been done after experiences with implementing the frameworks as described in Section 1.2. Much of the literature is so-called grey literature, especially from international organizations that collect and report this information in support of implementation in countries and furthering of their work. Scientific literature is often focused on specific issues and rather narrow, but is used when it yields insights into the success factors for mainstreaming and implementing climate adaptation in water management, with a focus on the transboundary level.

2.2. Case studies

Five case studies have been identified, including three transboundary river basins, one transboundary lake and one transboundary aquifer, that have shown successful mainstreaming of water climate adaptation. One case study was to be situated in a high-income region, one in a middle-income region and the others from a low-income region. At least two of the case studies should be situated in Africa. Selection was also done based on availability of information. The selected case studies are the Danube Basin, the Lake Victoria Basin, the Ramotswa aquifer, the Senegal Basin, and the Volta Basin.

Case study descriptions are made of transboundary basins, describing the specific basin, the existing mechanism to support the cooperation between the riparian countries, the potential and existing negative effects that they face because of climate change, the activities undertaken to adapt to these affects, and the lessons that are drawn in each basin about the process of developing and implementing an adaptation strategy. Most of the case study descriptions are developed on the basis of the regular reports by the respective basins to the Global Network of Basins (UNECE, 2022b) in preparation for subsequent meetings of the Network. When possible and relevant, the links between these basins and groundwater were included in the case study descriptions. The Ramotswa aquifer is not part of the Global network of Basins. This case study is largely based on RAMOTSWA project that was implemented by the International Water Management Institute (IWMI) together with the International Groundwater Resources Assessment Centre (IGRAC), Department of Water and Sanitation in Botswana, and the Department of Water and Sanitation in South Africa. A separate, in-depth case study description is made for each case study.





3. Literature review

3.1. Proposed analysis frameworks

Transboundary cooperation in water management is influenced by the characteristics of the issues in a basin and the characteristics of the general cooperation between the riparian countries. If the cooperation incentives of a specific problem are largely symmetric between the riparian countries and the problem pressure is high, the prospects for effective cooperation are good. When it comes to climate change adaptation, however, there is usually a high level of uncertainty that hinders a joint transboundary appreciation of the problem (Timmerman et al., 2011). The capacity of countries to adapt to changes over time is influenced by its natural and man-made capital assets, social networks and entitlements, human capital and institutions, governance, national income, health and technology, etc. (UNECE, 2009a).

Water management is based on implicit or explicit principles, rules and decision-making procedures that enable convergence of interests and expectations of stakeholders. Such a set of principles, rules and procedures is called a regime. There are five central elements that define a regime: political, legal, and institutional settings, information management approaches, and financial arrangements. Transboundary water management is more complex than national water management because the water management regimes usually differ more between countries than within countries. Transboundary water management requires coordination over the different regime elements in the different countries, especially where they contradict each other. If these elements and their interrelationships are shaped to support transboundary climate adaptation, the Enabling Environment comes into place (Table 1) (Raadgever et al., 2008; Raadgever & Mostert, 2005; Timmerman et al., 2011; Timmerman & Bernardini, 2009). The Enabling Environment framework will be the basis of the analysis.

The political setting refers to the goals and strategies of government, or other organizations, to reach those goals. Policies can be recorded in formal documents or followed in practice. Policies should fulfil current needs and have the ability to perform well in multiple possible futures and in a changing environment. A major challenge in managing transboundary waters is that no single government has complete control, and the waters are managed in the context of potential inconsistency and potential conflict of policies of the different countries involved.

The legal setting relates to the full set of national and international laws and agreements. Water management planning and implementation should be based on the existing legal framework and, in turn, may influence the legal framework. A legal framework includes arrangements for public participation, information management, financing, and planning, as well as many provisions concerning operational management, such as permitting but also provisions to regularly review and adapt policies.

The institutional setting refers to the formal organizational context as well as the informal actor networks. The integrated view on water management implies that there is a wide range of governmental and non-governmental stakeholders. Differences in institutional structure and different institutional mandates in riparian countries can hinder cooperation. Moreover, differences in capacities of institutions can also hinder good cooperation.

The information management refers to the collection and exchange of information within and between countries. Inconsistencies in information in riparian countries can lead to distrust and thus hinder cooperation. Proper information management is especially in a transboundary setting of utmost importance to support good cooperation.

The financial arrangements, finally, refer to the (financial) resources available to carry out and implement transboundary adaptation measures. Financial resources may come from national



budgets or from donors, but for good cooperation it is important that the riparian countries are together able to provide the resources needed for adaptation.

Table 1 Elements of the Enabling Environment and criteria connected to them (Raadgever & Mostert, 2005)

Element	Criteria
Policy setting	Long time horizon Flexible measures, keeping options open Experimentation Full consideration of possible measures Actual implementation of policies
Legal setting	Appropriate legal framework Adaptable legislation
Institutional setting	Cross-sectoral cooperation Cooperation between administration levels Cooperation across administrative boundaries Broad stakeholder participation
Information management	Joint/ participative information production Interdisciplinarity Elicitation of mental models / critical self-reflection about assumptions Explicit consideration of uncertainty Broad communication Utilization of information
Financial arrangements	Appropriate financing system

Transboundary cooperation in water management heavily depends upon social and institutional capacity, legal and policy frameworks, and management practices at the national level. If these are weak, this bears great consequences in the transboundary context and are amplified by differences between riparian countries. SDG indicator 6.5.2., that determines whether any agreement or arrangement that covers all or part of a transboundary river, lake or aquifer system is 'operational', rests on four criteria, namely (1) a joint (institutional) body is in place; (2) there are formal meetings (political or technical) between countries at least once per year; (3) a joint or coordinated management plan or joint objectives have been set; and (4) data and information is exchanged at least once per year (Rieu-Clarke et al., 2022; UNECE & UNESCO, 2017). These criteria fit into the Enabling Environment framework, largely the elements of the institutional setting and the information management.

The Task Force on Water and Climate under the UNECE Water Convention (UNECE, 1992) has reported lessons learned and good practices (UNECE/INBO, 2015) that were drawn from almost a decade of working on adaptation in transboundary basins, building on the framework of the guidance on water and adaptation (UNECE, 2009a). The lessons learned have been compared to the OECD principles on Water Governance (Box 2). The comparison showed that to fulfil one principle, a range of actions as coming from the lessons learned may be needed while almost all of these actions relate to two or more of the principles. For instance, the principle to 'Clearly allocate and distinguish roles and responsibilities' (Principle 1) relates to the Lesson 2 'Ensure political support for the basin-wide strategy', to Lesson 16 'Give a mandate to RBO to address climate change', and to nine other lessons. And Lesson 2 not only relates to Principle 1, but also to Principle 10 'Promote





stakeholder engagement' and two other principles. Good water governance is difficult to achieve in a single country and this is even more challenging when engaging two or more countries in a transboundary setting. Nevertheless, adaptation to climate change is inconceivable without progress on water governance in general (Timmerman et al., 2017).

The Enabling Environment framework (see Table 1) will be used in this study as the basis for analysis. This framework will be compared with the OECD principles and the results from the GCA study on mainstreaming and accelerating water climate adaptation at national and city level and will be complemented with insights from literature. This will result in an extended Enabling Environment framework that will be used to describe and analyze the case studies and will lead to recommendations on mainstreaming adaptation in water management at transboundary level.

Box 2 The OECD Principles on Water Governance (OECD, 2015)

Effectiveness

Principle 1. Clearly allocate and distinguish roles and responsibilities for water policymaking, policy implementation, operational management and regulation, and foster co-ordination across these responsible authorities.

Principle 2. Manage water at the appropriate scale(s) within integrated basin governance systems to reflect local conditions, and foster co-ordination between the different scales.

Principle 3. Encourage policy coherence through effective cross-sectoral co-ordination, especially between policies for water and the environment, health, energy, agriculture, industry, spatial planning, and land use.

Principle 4. Adapt the level of capacity of responsible authorities to the complexity of water challenges to be met, and to the set of competencies required to carry out their duties.

Efficiency

Principle 5. Produce, update, and share timely, consistent, comparable, and policy-relevant water and water-related data and information, and use it to guide, assess and improve water policy.

Principle 6. Ensure that governance arrangements help mobilise water finance and allocate financial resources in an efficient, transparent, and timely manner.

Principle 7. Ensure that sound water management regulatory frameworks are effectively implemented and enforced in pursuit of the public interest.

Principle 8. Promote the adoption and implementation of innovative water governance practices across responsible authorities, levels of government and relevant stakeholders.

Trust and engagement

Principle 9. Mainstream integrity and transparency practices across water policies, water institutions and water governance frameworks for greater accountability and trust in decision- making.

Principle 10. Promote stakeholder engagement for informed and outcome-oriented contributions to water policy design and implementation.

Principle 11. Encourage water governance frameworks that help manage trade-offs across water users, rural and urban areas, and generations.

Principle 12. Promote regular monitoring and evaluation of water policy and governance where appropriate, share the results with the public and make adjustments when needed.

3.2. Framework analysis

A first analysis is made in Table 2 where the OECD Water Governance principles are related to the elements of the Enabling Environment. Each principle clearly corresponds to one of the elements, based on the indicators connected to each principle and element. Table 2 also shows that all the principles correspond to the Institutional setting. This can be explained from the notion that each principle needs institutions and mechanisms to implement the principle. Also, five of the principles correspond to the legal setting. The institutional setting and the implementation process are laid down in the legal setting, which explains for these connections.





Table 2 OECD principles that correspond to elements of the Enabling Environment framework (blue shading indicates that there is some correspondence)

	Enabling Environment						
OECD Water Governance principles	Policy setting	Legal setting	Institutional setting	Information management	Financing		
Principle 1. Clear roles and responsibilities							
Principle 2. Appropriate scales within basin systems							
Principle 3. Policy coherence							
Principle 4. Capacity							
Principle 5. Data and information							
Principle 6. Financing							
Principle 7. Regulatory frameworks							
Principle 8. Innovative governance							
Principle 9. Integrity and transparency							
Principle 10. Stakeholder engagement							
Principle 11. Trade-offs							
Principle 12. Monitoring and evaluation							

An earlier study for GCA on mainstreaming and accelerating water climate adaptation at national and city level found that determining factors in the success or failure mostly lie in the human dimension. When looking for a framework to support mainstreaming of water climate adaptation the focus should therefore be on how the process can be shaped and how it can be ensured that it can be sustained for a prolonged period of time. This is even more true in a transboundary setting, as there are more actors involved with different (national) interests. The process should then be even better shaped to accommodate for these different interests. The success factors that the study identified, following from the cases in the national and urban study, were (GCA, 2022):

- 1. Urgency. This can come from internal drivers like disasters and extreme weather events, increased public awareness and concern, anticipation of the benefits of adaptation, or by playing a role as front-runner. External drivers can be efforts by international actors and financial support from International Financial Institutions (IFIs).
- 2. Leadership. There is a need for leadership that is willing to address the necessary transformation under uncertainty or at least to recognize the power and importance of water and climate adaptation as engine for economic development.
- 3. Coalition. Coalitions that include government agencies, donors and the private sector as well as (local) stakeholders have shown to provide an incentive for success.
- 4. Vision or strategy. The presence of long-term perspectives using scenario's, an integrated approach, and risk-based thinking are important elements to speed up the process as they provide a base outline. The vision or strategy does not need to be a concrete plan to support the process.
- 5. Communication. Transparency, trust, and accountability are the basis for successful mainstreaming and societal debates should therefore be promoted.
- 6. Capacities. Involved actors as well as the public at large need to be equipped with the means to understand the needed adjustments on the short and long term. This includes a more holistic approach and understanding of risks and uncertainties.





- 7. Information. Data-based evidence and information to understand the issues at stake is paramount for adaptation. In this, facts are essential for policies and plans but making the assumptions and interpretation of data and information explicit as well, as this enables debate and avoidance of maladaptation.
- 8. Finances. Continued financial resources that are needed for the long-term perspective. Funding should therefore not be opportunity-driven.
- 9. Understanding of barriers. The complexity and multi-level nature of climate change require governance systems and people able to manage and resolve conflicts of interests across multiple scales and among diverse policy actors.
- 10. Change management approach. Adaptation in many cases requires change, away from the 'business-as-usual' approach that is often taken. This is even more important since the future situation can no longer be extrapolated from the past.
- 11. Risk based approach. Climate change affects many parts of society, ranging from infrastructure and people to economy. A risk-based approach enables focusing on those parts that are at highest risk.
- 12. Long term commitment. Adaptation requires a long-term perspective as well as an approach that is able to adapt on the way as the effects of climate change unfold. This asks for committing to a long-term process.

Table 3 shows the correspondence between the elements of the Enabling Environment and the key success factors as identified in the GCA national and urban mainstreaming study are shown. It is clear that there is no straightforward connection between the two frameworks. From the table it follows that especially the legal setting is not reflected in the key success factors.

	Enabling Environment						
Key success factors	Policy setting	Legal setting	Institutional setting	Information management	Financing		
Urgency							
Leadership							
Coalition							
Vision or strategy							
Communication							
Capacities							
Information							
Finances							
Understanding barriers							
Change management approach							
Risk based approach							
Long term commitment							

Table 3 Elements of the Enabling Environment corresponding to elements of the success factors from the GCA national and urban mainstreaming study (blue shading indicates that there is some correspondence)

Table 4 shows the correspondence between the OECD Water Governance principles and the key success factors as identified in the GCA national and urban mainstreaming study. The table shows that also here, there are not always clear relationships between the two frameworks and that





several of the success factors correspond to several principles, and vice versa. On the part of the principles, the regulatory framework does not correspond to a success factor. On the other hand, success factors Urgency, Understanding barriers, Change management approach, Risk based approach, and Long-term commitment have no correspondence to one of the principles. This can be explained from the notion that the OECD principles focus on *what* needs to be done, while the success factors more relate to the *how* it is done.

In the Water Governance principles, we see a framework that focuses on how an existing governance system, both formal and informal, should function in an ideal situation. The Enabling Environment framework adds to this a reflection on the formal system in view of the necessary changes. The key success factors show that at the end of the day, the way key actors perform is essential to achieve change. Each framework thus has its limitations.

Working on adaptation in general means working in an unknown territory. This requires a transformative approach to make the change to a new 'normal'. Transformations are generally understood as a radical change of the identity of a specific system including its fundamental components and feedback mechanisms. Climate change needs understanding of the systemic changes (systemic perspective) and the multi-dimensionality of it (systemic insight). Transformation can then occur by addressing the complexity (cross-sectoral, multi-scale), the long-term horizon, the need for co-evolution, include flexibility and adaptation for risk management to address the uncertainty, and use of threshold effects by using crises as opportunities. This requires developing a long-term vision for sustainability and resilience, and good governance and co-creation. Governance is then largely about creating the conditions for this process that enable innovation and strategic phase-out of existing unsustainable path-dependencies and lock-ins driving highemissions, unsustainability, maladaptation, and vulnerability (Hölscher & Frantzeskaki, 2020). Four dimensions of governance capacity determine if the governance system allows for change (Hölscher, 2020):

- 1. Governance conditions: the (institutionalized) working arrangements and the broader socioeconomic and political contexts;
- 2. Governance agency: governance actors who mobilize, create, and change governance conditions for collective action;
- 3. Mediation processes: the collective practices through which governance relations are played out;
- 4. Normativity: does the governance allow for generating socially desirable and legitimate outcomes;

The governance conditions that Hölscher (2020) describes are reflected in the OECD governance principles. The governance agency shows the need for a proper institutional setting. The normativity resonates with leadership and vision but also with a solid policy setting. The mediation element is a new element that may be added. In the transformation approach we see the systemic perspective and insight, and the long-term horizon relating to the holistic, long-term, flexible approach as well as the need for governance that is described in the three frameworks as discussed in the previous section. Using crises as opportunities relates to urgency. Creating the conditions in governance closely relates to the Enabling Environment. Also, the formal and informal system come together with the human dimension, where implementation of adaptation can he highly dependent on the way the key actors act. The complexity and the need for co-evolution do not yet resonate in the various elements we have seen so far and may need to be added.





Table 4 OECD principles that correspond to elements of the success factors from the GCA national and urban mainstreaming study (blue shading indicates that there is some correspondence)

OECD Water Governance principles	Urgency	Leadership	Coalition	Vision or strategy	Communication	Capacities	Information	Finances	Understanding barriers	Change management approach	Risk based approach	Long term commitment
Principle 1. Clear roles and responsibilities												
Principle 2. Appropriate scales within basin systems												
Principle 3. Policy coherence												
Principle 4. Capacity												
Principle 5. Data and information												
Principle 6. Financing												
Principle 7. Regulatory frameworks												
Principle 8. Innovative governance												
Principle 9. Integrity and transparency												
Principle 10. Stakeholder engagement												
Principle 11. Trade- offs												
Principle 12. Monitoring and evaluation												





3.3. Identification of key success factors from literature

Looking further into key success factors as identified in literature, a range of issues are identified that are considered necessary for mainstreaming and implementation of adaptation, with a focus on transboundary cooperation. In random order (ADB, 2022; Hölscher, 2020; Lebel et al., 2012; Parven & Hasan, 2018; Sondermann & de Oliveira, 2021; UNECE, 2009b; UNECE/INBO, 2015; UNECE/UNISDR, 2018; UNEP, 2021):

- A joint problem definition and a common understanding of the vulnerability in a basin and the interests among all riparian countries, and, based upon that, a forward-looking shared vision on resilience;
- Horizontal communication and coordination and alignment of policies and institutional collaboration between water-related sectors and stakeholders, and between the riparian countries, and vertical communication and coordination and between national, subnational and basin levels;
- Synergies and linkages between adaptation actions at different government levels (local, national, regional, transboundary) and between different (economic) sectors;
- Financing that includes governance issues and capacity building;
- Capacity of institutions to enforce legislation and to develop and implement cross-sector programs;
- Monitoring and data- and information-sharing from the entire basin. This includes compatibility of data and data formats and a water balance for the entire basin;
- Proper institutional arrangements;
- Application of the principles of IWRM including a holistic approach that accounts for the complexity of the process;
- A solid science base, for instance, coming from a joint group of experts;
- Capacity among all stakeholders for, among others, using climate information, managing the uncertainties in the development of scenarios and implementation of measures, for using the appropriate tools and for integrating adaptation into the basin management plan;
- Integrated scenarios that take into account climate change but also other changes, such as in demography, economic growth, food preferences, etc.;
- A flexible and adaptable adaptation plan (national or transboundary) at the basin scale that is subsequently integrated into an (existing) basin management plan;
- As measures are generally taken at the local scale it is important that plans and policies enable locally appropriate responses;
- Take a risk-based approach, identifying the risks and vulnerabilities, and adaptation options. This is an ongoing process;
- Monitor and evaluate adaptation strategies and learn from them.
- Start with existing policies and plans, and implement environment and development measures that have already been identified;
- Consider climate change adaptation as a development issue, rather than an environmental one. This may also help to avoid conflicts with other priority policy issues;
- Identification of the benefits of cooperation;
- Facilitate trust building and collaborative learning. Collaborative learning with a range of stakeholders allows for co-evolution;
- Joint bodies such as river basin commissions;
- A joint transboundary flexible legal framework;
- Harmonized water resource management practices;





- Combined meteorological and hydrological monitoring and forecasting systems to provide timely information on the extent and severity of extreme events;
- Mitigation aspects are considered when developing adaptation measures and vice versa.

Overall, a fundamental challenge lies in achieving political commitment at the highest levels and across sectors. That is why decision makers need to be involved in the adaptation process from the beginning, to ensure that the process relates to policymaking and to ensure the transfer of knowledge from science to decision makers and the political sphere. It should be kept in mind that transboundary cooperation on adaptation often starts at a technical, or expert, level that can later positively influence cooperation in general, also at a political level (UNECE/INBO, 2015; UNEP, 2021).

When it comes to transboundary cooperation, adaptation requires strong cooperation between the riparian countries on a cross-cutting issue with conflicting and competing needs across multiple physical, political, and jurisdictional boundaries and is therefore a particular challenge. On the other hand, by pooling available data, models, scenarios, and resources and enlarging the planning space for locating adaptation measures, transboundary cooperation can enable more efficient and effective adaptation. A joint vulnerability assessment based on common models and scenarios, and commonly agreed information and methodologies is then especially important, as reducing vulnerability in one part of the basin can affect vulnerability elsewhere in the basin. Adaptation measures are best prioritized on a basin perspective to avoid measures that transfer vulnerability within the basin to another location. Adaptation measures should be located at the "optimal" location in the basin, and this may involve payments for measures located in other riparian countries (UNECE/INBO, 2015).

Several factors come back in the various frameworks and the literature. In the next section, based on the Enabling Environment framework, the different factors will be combined to develop an overall analysis framework.

3.4. Approaching mainstreaming of water climate adaptation

Based on the findings from literature as listed above, additional factors can now be assigned to the five elements of the Enabling Environment framework (see Table 1). These will be synthesized in this section. The factors will subsequently be used to assess the case studies. Table 5 provides an overview of selected criteria that are included in five important sources. Not all sources touch upon all elements of the Enabling Environment framework. Also, not all criteria are included in the table.

Source	Element	Criteria
(GCA, 2022)	Policy setting	Urgency Leadership Understanding barriers Change management approach Risk based approach Long term commitment
	Legal setting	
	Institutional setting	Coalition Capacities Understanding barriers

Table 5 Overview of selected criteria for five important sources structured along the elements of the Enabling Environment framework





Source	Element	Criteria
	Information management	Communication Information Risk based approach
	Financial arrangements	Finances
(Hölscher, 2020)	Policy setting	 Anticipating and responding to long- term change, uncertainty, and risks Creating and embedding novelties Generating knowledge about system dynamics Strategic Alignment Mediating across scales and sectors
	Legal setting	
	Institutional setting	Strengthening self-organisation Coordinating multi-actor processes to create synergies and avoid trade- offs
	Information management	Monitoring and continuous learning
	Financial arrangements	
(OECD, 2015)	Policy setting	Policy coherence Innovative governance
	Legal setting	Clear roles and responsibilities Regulatory frameworks
	Institutional setting	Appropriate scales within basin systems Capacity Integrity and transparency Stakeholder engagement Trade-offs
	Information management	Data and information Monitoring and evaluation
	Financial arrangements	Financing
(Raadgever & Mostert, 2005)	Policy setting	Long time horizon Flexible measures, keeping options open Experimentation Full consideration of possible measures Actual implementation of policies
	Legal setting	Appropriate legal framework Adaptable legislation
	Institutional setting	Cross-sectoral cooperation Cooperation between administration levels Cooperation across administrative boundaries Broad stakeholder participation





Source	Element	Criteria
	Information management	Joint/ participative information production Interdisciplinarity Elicitation of mental models / critical self-reflection about assumptions Explicit consideration of uncertainty Broad communication Utilization of information
	Financial arrangements	Appropriate financing system
(UNECE/INBO, 2015)	Policy setting	Demonstrate the benefits of basin-wide cooperation in adaptation Adopt a flexible approach to climate change adaptation in the transboundary basin Ensure synergies and linkages between adaptation actions at different government levels and across different sectors Involve all sectors and ministries in defining adaptation priorities Facilitate trust building and collaborative learning Ensure stakeholder participation
	Legal setting	Implement existing transboundary agreements in a flexible way
	Institutional setting	Give a mandate to river basin organizations to address climate change Apply transparency and openness throughout the process Build transboundary teams among scientists, administrative authorities, non-governmental groups, and technical experts to enable joint actions, such as assessments Identify the needs for capacity development Ensure the exchange of knowledge between technical specialists and decision makers
	Information management	 Tailor messages to your audience, based on its characteristics and needs Identify information needs and processes for assessing, gathering, compiling, and exchanging information Ensure collection and sharing of the appropriate and necessary data, information, and models for the entire basin and across the water cycle
	Financial arrangements	Ensure adequate financing for adaptation through a mix of public and private funds Use economic instruments for water management to reduce baseline stress and provide flexibility to changing conditions

In the following sections, for each element of the Enabling Environment framework a short discussion of the various sources will be given, where the important criteria are highlighted in blue. The criteria from the different sources are merged and sometimes clustered and are listed in Table 6.

3.4.1. The policy setting

Water policies can be found in the formal documents but can also be informal and not documented, and ideally lay down a vision on the future. Policies have a strategic character, and they should have a long-term time horizon, especially in view of climate change. Policies also steer governance. Water management policies should be based on an integrated understanding of the basin and the climate





impacts and trends, including an understanding of the interconnections between regional impacts. Integrated policies should also be coherent. Uncertainty in climate change predictions asks for a flexible approach to policies and strategies and these should include possibilities for experimentation and innovation. A benefit assessment exercise can help countries to fully realize the potential benefits of cooperation and provide arguments and compelling evidence for cooperating. Especially in transboundary basins, a fair distribution of benefits, risks and welfare may be complex. Policies should also incorporate nature-based adaptation and hybrid approaches as a cost-effective alternative to 'grey' infrastructure. At the basis of cooperation lies a level of mutual trust that can be enhanced by collaborative learning (Timmerman et al., 2017; UNECE/INBO, 2015).

There is a need for more polycentric governance, that is, governance of transboundary waters downward to the local level, linking regional and local processes (Baltutis & Moore, 2019; Chen et al., 2013). This involves, e.g., a flexible and adaptable adaptation plan (national or transboundary) at the basin scale that is subsequently integrated into an (existing) basin management plan and includes synergies and linkages between adaptation actions at different government levels (local, national, regional, transboundary) and between different (economic) sectors (UNECE/INBO, 2015). Looking at the frameworks we use for the analysis, several elements can be derived that the policy setting in a transboundary water management context has to fulfil the following (GCA, 2022; Hölscher, 2020; Raadgever & Mostert, 2005; UNECE/INBO, 2015):

- Policies must be based on and committed to implementing a long-term vision or strategy;
- Policies must be flexible and innovative, using experimentation and be change-oriented;
- Policies must be coherent and have a holistic approach, taking into account the broader socio-economic and political contexts, and taking into account mitigation aspects when developing adaptation measures and vice versa;
- Policies must be based on a risk approach;
- Policies must be based on a joint problem definition and a common understanding of the vulnerability in a basin, developed through a broad stakeholder involvement process that allowed for generating socially desirable and legitimate outcomes;
- Policies must be based on the principles of IWRM;
- Policies must include identifying the benefits of cooperation between riparian countries;
- Within the policy development there needs to be room for trust building and collaborative learning; and
- Policies must be based on a solid science base, for instance, coming from a joint group of experts.

In all this, it is important that the policies when formulated, are actually implemented. This involves a form of leadership that understands the possible barriers but that is also aware of the urgency of taking measures (GCA, 2022; UNECE/INBO, 2015).

3.4.2. The legal setting

The legal framework entails the full set of national and international laws and agreements (Timmerman & Bernardini, 2009). Laws can be a barrier, because they often reflect a past situation, but (international) laws may also help to create a window of opportunity, remove barriers, or raise the urgency of adaptation (Cosens et al., 2017). What is needed is an appropriate legal framework that is adaptable (Raadgever & Mostert, 2005). The legal framework should clearly describe the roles and responsibilities of the different actors, should ensure the integrity and transparency of the water management process and should include stakeholder engagement that enables making trade-offs between the various interests. And, the regulatory frameworks in place should be implemented (OECD, 2015). In a transboundary context there is a need for a joint transboundary





flexible legal framework based on the principle of equitable utilization (McIntyre, 2010; UNECE/INBO, 2015). In this sense, international water treaties and management have a crucial role to ensure fair management of transboundary water resources (Munia et al., 2020).

3.4.3. The institutional setting

Institutions structure political, economic, and social interaction. They consist of both informal constraints and formal rules (North, 1991). Within institutions, interactions take place that can promote constructive conflict resolution, can enhance information flow, ensure collaboration across scales, and provide for social memory in formal networks and informal actor networks. Proper institutional arrangements are needed for institutions to have the capacity to carry out the necessary horizontal and vertical communication and coordination, building coalitions, and alignment of policies and to enforce legislation. The necessary data and information as well as financing need to be arranged and the integrity and transparency needs to be assured. The institutions must be able to respond to the long-term, flexible, risk-based policies. Also, all stakeholders need to have the capacity for, among others, managing the uncertainties in the development of scenarios and implementation of measures, for using the appropriate tools and for integrating adaptation into the basin management plan. And institutions, especially in a transboundary context, need to be able to harmonize water resource management practices and have shared monitoring and data acquisition, based on a joint vision and management objectives (Hölscher, 2020; OECD, 2015; Raadgever & Mostert, 2005; Schmeier & Vogel, 2018; Timmerman et al., 2011). All in all, effective institutions must have a clear purpose, objective, and role, the necessary power and duties to perform its activities, clear decision rules to ensure integrity and transparency of its actions and be accountable and responsible, have the necessary competence and expertise, and be able to take a mediation role (Hölscher, 2020; Meran et al., 2021). A joint body may take up the latter steered by the principle that a joint body ensures to have neutral facilitators (UNECE, 2018).

In a transboundary water management situation, river basin organizations (RBOs) are critical to implement transboundary treaties and strategies (UN Environment, 2021). In the work of an RBO it is important to balance between a centralized approach and involving local communities to find effective and equitable solutions. Proper selection and involvement of stakeholders is therefore crucial (Kranz & Mostert, 2010; Meijerink & Huitema, 2017; Saha et al., 2021). Where RBOs generally have a mandate for surface water management, inclusion of groundwater management is recommended and growing (Lautze et al., 2018).

3.4.4. Information management

Information is essential in water management. Information is needed to assess the current situation of the basin and existing affects and vulnerabilities, and through models and scenarios develop understanding of possible futures. There is also a need to monitor policy progress (Timmerman, 2012, 2021). Especially in a transboundary context, information production needs to be done jointly, ensuring mutual access to information and enable broad communication and utilization of the information. The latter also refers to the relevance of the information for decisionmakers. It includes compatibility of data and data formats but also harmonized scenarios and models (OECD, 2015; Raadgever & Mostert, 2005; Timmerman, 2021).

3.4.5. Financial arrangements

Ensuring sustainable transboundary water management requires sufficient resources to produce a diverse set of public goods (e.g., flood protection and water quality management) and market goods (e.g., hydropower), as well as the costs of the management process itself (e.g., office and travel





costs). Domestic budgetary resources from riparian states are and should remain the primary funding source to support joint bodies core costs and basin water management activities. Where national financial resources are insufficient, they be complemented with resources drawn from the global climate regime, private finance, and overseas development assistance. Financing for both mitigation and adaptation is growing globally and private finance for climate-related projects is increasing, especially for larger infrastructure projects. Nevertheless, access to funds and effective implementation, particularly for regional approaches, poses challenges as transboundary approaches bring complexities to a project, such as the involvement of multiple countries, legal responsibility and mandate for implementation, and the challenges of sharing up-stream or downstream benefits and commitments. Therefore, joint bodies with shared basins must create an Enabling Environment by building strong legal and institutional frameworks, strengthening governance, and elaborating plans for basin development next to an appropriate financing system to mobilize financial resources (OECD, 2015; Raadgever & Mostert, 2005; Timmerman & Bernardini, 2009; UNECE, 2021a; World Bank, 2019).

3.4.6. Key factors for the Enabling Environment

In the previous paragraphs, the key factors from different sources are clustered and assigned to the five elements of the Enabling Environment framework. Some of the factors are mentioned for more elements, these will be assigned to the most relevant element to avoid duplication. Table 6 provides an overview of the key factors.

Element	Key factor
Policy setting	Long-term vision or strategy Flexible Innovative – experimentation Change-oriented Coherent Holistic approach Risk-based approach Joint problem definition and common understanding Broad stakeholder involvement IWRM Benefits of cooperation Trust building and collaborative learning Solid science base Leadership
Legal setting	Appropriate legal framework Adaptable/flexible Roles and responsibilities Integrity and transparency Equitable utilization Enforce legislation
Institutional setting	Horizontal and vertical communication and coordination Coalition Capacity development – competence and expertise Harmonized water resource management practices Purpose, objective and role Power and duties

Table 6 Key factors for the five elements of the Enabling Environment framework





Element	Key factor
	Mediation
Information management	Mutual access to information
	Monitor policy progress
	Broad communication and utilization of information
	Compatibility of data and data formats
	Harmonized scenarios and models
Financial arrangements	Domestic budgetary resources
	Access to funds
	Effective implementation





4. Results of the case study analysis

4.1. Case studies

An extensive description of the case studies has been developed and included as annexes to this report. Here, only a short reflection of the full case is given that highlight the main aspects relevant for the assessment. An overview over the five case studies is given in the next section.

4.1.1. Danube River Basin

The Danube River Protection Convention establishes and lays down the mandate for the International Commission for the Protection of the Danube River (ICPDR). The ICPDR follows the approach of Integrated Water Resources Management (IWRM) as basis of its activities. A Climate Change Adaptation Strategy for the Danube River Basin was developed in 20212 based on a vulnerability assessment and was fully integrated in the second Danube River Basin Management Plan in 2015. National adaptation activities were analyzed and taken on board during the elaboration of the study that provided the basis for the Strategy. As a result of the 2012 Climate Change Adaptation Strategy, a common basin-wide understanding and development of a joint approach towards addressing the issue was generated (UNECE, 2016). An updated ICPDR Strategy on Adaptation to Climate Change was finalized in 2018. The ICPDR Climate Change Adaptation Strategy considers an effective long-term monitoring to enable climate change signals to be identified and reacted to in due course, as one of the key implementation issues (ICPDR, n.d.; UNECE, 2011, 2016, 2019).

At the end of 2019, the ICPDR adopted the "Effects of climate change" as additional Significant Water Management Issue (SWMI) in the Danube River Basin. Throughout 2021, the Danube River Basin Management Plan (DRBMP) Update 2021 together with the Danube Flood Risk Management Plan (DFRMP) Update 2021 have been elaborated and reviewed with the involvement of stakeholders and the public alike, throughout the Danube River Basin during the ICPDR's Public Consultation Process. The ICPDR is working in close cooperation with its Observer Organizations which include representatives from different sectors (e.g., navigation, hydropower, etc.), NGOs and other interested parties as well as with scientists for specific studies. The ICPDR is financed by the countries. Financing of the implementation of measures is done by the individual countries and in many cases co-financed by EU and other international funding instruments (UNECE, 2013, 2014, 2016, 2019, 2021b, 2022a).

Almost all the criteria of the Enabling Environment framework are met in the Danube. The ICPDR is thus regarded as a successful model for transboundary water management, among others, by the emphasis the ICPDR places on participation at all stages and levels of its work. This focus on joint responsibility and awareness-raising is a good example for transboundary water management (Wolf & Newton, 2010b).

4.1.2. Lake Victoria Basin

The LVBC was established through the Protocol for Sustainable Development of the Lake Victoria Basin (the "LVBC Protocol"). The Commission is mandated to coordinate sustainable development and management of the Lake Victoria Basin. The main agreements governing the Lake Victoria Basin fall under the institutional umbrella of the East African Community (EAC) (IWG, 2022a; LVBC, 2022).

The strategy concerning climate change is laid down in the LVB Climate Change Adaptation Strategy and Action Plan (2018-2023). The LVB Climate Change Strategy was developed jointly with all the six Countries of the EAC. The strategy and plan are implemented through projects. Awareness raising is largely done through trainings. Several initiatives are undertaken to improve the





cooperation, a.o., by developing instruments like a data and information sharing protocol, and alignment of activities to national priorities (IWG, 2022a; UNECE, 2022a).

The LVBC is funded from the EAC budget, stakeholders' contributions, development partners and other sources (IWG, 2022a). The legal status of the LVBC is recently strengthened (IWG, 2022a; LVBC, 2022; UNECE, 2019, 2021b, 2022a). Although many criteria of the Enabling Environment framework are met, it may be clear that the cooperation in the LVBC is still in a process of improving.

4.1.3. Ramotswa Transboundary Aquifer

Under the RAMOTSWA project, a Joint Strategic Action Plan (JSAP) for the Ramotswa Transboundary Aquifer Area (RTBAA) was developed. The JSAP was developed based on an overarching joint vision and framework for the RTBAA. Objectives, targets and actions were identified, and the actions were reviewed for their compatibility with the current institutional framework. There was active leadership from the respective government ministries. The project took an integrated approach and looked at the vulnerability and the socioeconomic importance of the aquifer. The project has led to an improved understanding of aquifer management and its role in resilience and sustainable development (IWMI, 2020; Lazurko et al., 2020; UNESCO-IHP, 2021).

There is no specific agreement dealing with the Ramotswa aquifer, but there is a series of agreements on which the management of the aquifer can build that provide the overall legal framework for equitable utilization of the water resources. The RAMOTSWA project initially provided for a clear working structure. The project led to the establishment of a Groundwater Committee under the Limpopo Watercourse Commission (LIMCOM) structure, which also shows flexibility in the legal structure. The clear structure provides for transparency (Lautze et al., 2019).

The RAMOTSWA project structure was clearly based on including horizontal and vertical communication and coordination through the involvement of the Department of Water Affairs of Botswana and the Department of Water and Sanitation of South Africa, that together with the International Water Management Institute (IWMI) and the International Groundwater Resources Assessment Centre (IGRAC) formed a coalition. The joint vision was based on the visions and policies of the respective governments. By incorporating the aquifer management into the LIMCOM structure, the objective and role as well as the power and duties for the management of the aquifer are clear and the different international agreements can be realized. The project also acted as a capacity development exercise, improving the competence and expertise of the involved personnel and as there were few groundwater-management measures in place, the project led to a harmonized practice. The project acted as a mediator to establish a more permanent structure (GRIPP, 2019; Lazurko et al., 2020).

In the RAMOTSWA project, the Ramotswa Information Management System (RIMS) was developed to provide access to compatible maps, data and information related to the aquifer system and the socioeconomics in the study area. The online portal is publicly available. The JSAP was developed on the basis of a Transboundary Diagnostic Analysis (TDA) and this implicitly is the harmonized approach. Implementation of the actions is tracked (Altchenko et al., 2017; IGRAC, 2019).

The RAMOTSWA project was externally funded. After finalization of the project, the LIMCOM became responsible for the management of the Ramotswa transboundary aquifer and will be part of the LIMCOM funding arrangements.

Although not always straightforward, the criteria of the Enabling Environment framework are met. This case study clearly shows that a project can initiate transboundary cooperation in a situation where this cooperation is not institutionalized. It also shows that initiating and cooperating in a project can be a way of showing leadership towards improved cooperation in a situation that is not politicized and is a way to build the necessary trust. Also, the aspect of time plays a role as it is





concluded that the processes are lengthy and this should be accounted for (UNESCO-IHP, 2021). Nevertheless, where the project could successfully be finalized, the sustainability of the management of the Ramotswa transboundary aquifer depends on the further implementation within the framework of LIMCOM. Within this framework, trade-offs will be made that can affect sustainable management, e.g., from limited funding.

4.1.4. Senegal River Basin

The OMVS has a Strategic Environmental Action Plan for 2037 detailing adaptation actions as well as a Regional Adaptation Plan to Climate Change for 2050 and a Climate Investment Plan (CIP). A multisectoral development program, the Integrated Water Resources Management Project (PGIRE), is running to strengthen the regional integration of the four riparian countries and improve the living conditions of the populations. There is regular updating of strategic documents and pilot adaptation projects are carried out. The Advisory Committee strengthens the involvement and participation of users, political actors, researchers, civil society, etc., and OMVS has partnerships with several universities. The OMVS recognizes the importance of capitalizing on the expertise and experiences of Member States (OMVS, 2021; UNECE, 2022a). The joint funding of the OMVS is based on the likely benefit accrued (Wolf & Newton, 2010a). An important lesson from the work of the OMVS has been that a profound change in the behavior of the basin's population is needed (UNECE, 2021b).

The OMVS, based on the Convention Establishing the Organization for the Development of the Senegal River, embodies a flexible framework for the management of the Senegal River Basin by all four of the riparian states (IWG, 2022b; Wolf & Newton, 2010b). Through the longstanding cooperation in the OMVS, almost all the criteria of the Enabling Environment framework are met.

Several bodies under the OMVS together take care of the alignment of policies among the Member States and the implementation of the projects and programs. Awareness raising and capacity development are important elements of the implementation program (OMVS, 2021; UNECE, 2014).

Diagnostic surveys and vulnerability assessments have been done, and exchange visits are initiated to share successful experiences. Information management is coordinated by OMVS including capacity building, development of models, hydrometeorological monitoring network, harmonization of regulations, etc. at regional and local level (UNECE, 2016, 2021b, 2022a).

The regular budget for OMVS is funded by contributions from the four Member States. Next to that, loans for development projects and donations allow for implementation of projects and programs. from bilateral and multilateral partners (UNECE, 2016, 2021b, 2022a).

4.1.5. Volta River Basin

The Volta Basin Authority (VBA) was established in 2006. The mission assigned to the VBA revolves includes permanent consultation between stakeholders, and implementation of Integrated Water Resources Management and an equitable distribution of the benefits drawn from the different uses made of the resource. The VBA has a Strategic Action Plan 2014-2024 and the Volta River Basin Strategic Action Programme Implementation Project (VSIP) to implement it. Studies are conducted in the framework of the various projects (VBA, n.d.). Despite many positive developments there are still problems in communication among agencies at the national level and some of the critical decisions are not being taken jointly (WMO, 2022). The cooperation in the VBA is gradually improving and many of the criteria of the Enabling Environment framework are met.

Some results of activities under the VBA include collection and validation of data on exposure to climate hazards, capacity building of stakeholders, informing the public and raising awareness, and data collection tools (UNECE, 2019, 2021b, 2022a). The irrigation project in Burkina Faso shows that cooperation can be accomplished through the VBA (UNECE, 2022a).





The VBA is financed through contributions from the Member States (VBA, 2007). Programs and project are financed through external funds (UNECE, 2022a).

4.2. Analysis of the case studies

4.2.1. Key factors

Based on the case study descriptions, an analysis is made of whether the key factors as identified in Section 3.4.6 are present in each case study (see Table 7). It must be emphasized here that the analysis is based on the available information and is subjective. Moreover, the mere fact that a certain factor is mentioned and therefore scored as being present (for instance, flexibility is mentioned in a strategy document) is no guarantee that it is indeed implemented. Vice versa, if a factor is seemingly not present it may still have been implemented in an implicit way. The scores therefore give an indication, but it is up to the actors in the respective basin if the factors are present and sufficiently implemented.

Table 7 Overview of whether the key factors are present for each case study. The scores are as follows: + means the key factor is present, - means the key factor does not seem to be present, +/- means that the key factor was present but may no longer be present in the future, ? means that it is not clear if the key factor is present.

		Danube	Lake	Ramotswa	Senegal	Volta
		River	Victoria	Transboundary	River	River
	Key factor	Basin	Basin	Aquifer	Basin	Basin
Policy setting	Long-term vision or strategy	+	+	+	+	+
	Flexible	+	?	+	+	-
	Innovative – experimentation	+	-	+	?	-
	Change-oriented	+	-	+	+	-
	Coherent	+	+	+	+	?
	Holistic approach	+	+	+	+	+
	Risk-based approach	+	+	+	+	+
	Joint problem definition and common understanding	+	?	+	+	?
	Broad stakeholder involvement	+	-	+	+	+
	IWRM	+	+	+	+	+
	Benefits of cooperation	-	-	+	+	+
	Solid science base	+	?	+	+	+
	Trust building and collaborative learning	+	+	+	?	-
	Leadership	+	+	+	+	?
	Urgency	+	+	+	+	+
Legal setting	Appropriate legal framework	+	+	+	+	+
	Adaptable/flexible	+	?	+	+	?
	Roles and responsibilities	+	+	+	+	+
	Integrity and transparency	+	+	+	+	+
	Equitable utilization	+	?	+	+	+
	Enforce legislation	+	+	+	+	+
Institutional setting	Horizontal and vertical communication and coordination	+	+	+	+	-
	Coalition	+	?	+	?	+
	Capacity development – competence and expertise	+	+	+	+	+
	Harmonized water resource management practices	+	?	+	+	?
	Purpose, objective and role	+	+	+	+	+
	Power and duties	+	+	+	+	+
	Mediation	+	?	+	?	+





		Danube River	Lake Victoria	Ramotswa Transboundary	Senegal River	Volta River
	Key factor	Basin	Basin	Aquifer	Basin	Basin
Information	Mutual access to information	+	-	+	+	-
management	Monitor policy progress	?	-	-	+	-
	Broad communication and utilization of information	+	-	+	+	+
	Compatibility of data and data formats	+	-	+	+	-
	Harmonized scenarios and models	+	+	+	+	-
Financial	Domestic budgetary resources	+	-	+	+	+
arrangements	Access to funds	+	+	+	+	+
	Effective implementation	+	+	+/-	+	?

In the Danube case, most key factors are present. There is no explicit mentioning of looking at the benefits of cooperation while it is not clear of progress in policies is monitored. The Danube Basin has the relative advantage that most of the countries in the basin are EU members that have to abide to EU-regulations, which is helpful in setting the goals as well as the process through the River Basin Management Plans and the Flood Risk Management Plans. In the Ramotswa case, also most key factors are present. Monitoring of progress in policies is not present and it is not clear if the implementation will be maintained. The analysis in Table 7 is mainly based on the RAMOTSWA project that has the advantage of being limited in scope even though the project followed an integrated approach. In the Senegal case most of the key factors are present, with some questionmarks for innovation, coalition, and mediation. The OMVS has some 50 years of history that has been accommodating for the development of a stable cooperation. For the Lake Victoria and the Volta cases, more key factors seem to be missing. The cooperation in these two basins is relatively young (20 and 15 years respectively) and the cooperation may not have fully crystallized.

Factors that are missing include the flexible, innovative, and change-oriented approaches, looking at benefits of cooperation, forming of coalitions, harmonizing of practices, mediation, monitoring of policy progress, and general information management. For the case studies, lessons learned have been described. These lessons learned generally reflect many of the key factors as listed but did not add additional factors.

4.2.2. Groundwater

Groundwater is often perceived as a private resource, often closely connected to land ownership, and regulation and top-down governance and management, planning and policy implementation are difficult. Legal frameworks need to include protection of discharge and recharge zones and therefore, conjunctive management of surface water and groundwater is recommended. This is even more necessary when there are conflicts between groundwater rights and surface water rights (Lautze et al., 2018; UNESCO-WWAP, 2022). Although there is interest in groundwater in the cases, arrangements are generally not well established. A good example is that a Regional Working Group (RWG) for Transboundary Cooperation on the Senegal-Mauritanian Aquifer Basin (SMAB) has been established in 2020, comprising the States (The Gambia, Guinea Bissau, Mauritania, and Senegal) as well as the transboundary basin organizations covered by the SMAB, namely, the Organization for the Development of the Gambia River (OMVG) and the OMVS. The RWG has a mandate to provide support and advice to States and transboundary basin organizations to establish transboundary cooperation for a concerted sustainable management of the SMAB. A vision has been developed on the integrated development of groundwater and surface water resources, capitalizing on more than half a century of experience in the concerted management of the sub-region's major rivers (UNECE,





2020). Another example is the Ramotswa Transboundary Aquifer, where the management has been inserted under the LIMCOM.





5. Discussion and conclusions

The analysis of the cases in this report is not straightforward; the key factors are not unequivocally defined, and the presence of a key factor can be weak or strong. Furthermore, although much effort has gone into finding the right information on the cases, certain information may be missing. And overall, the scores are sometimes based on terms as used in a range of documents and websites where a definition or explanation of the term is often not provided. The analysis is therefore subjective.

Next to this, the case studies differ much. The ICPDR is a joint body that exists for over 25 years while most of its Member States are also EU Member States that must comply to EU rulings which has a harmonizing effect. The LVBC is a joint body under the East African Community (EAC) that is indirectly funded by the Member States and has a history of less than 20 years. The Ramotswa Transboundary Aquifer case study is largely based on the RAMOTSWA project that was externally funded. A Groundwater Committee was established in 2019 under the Limpopo Watercourse Commission (LIMCOM) to advance the joint management of aquifers, among which the Ramotswa Transboundary Aquifer, in the Limpopo Basin. The effects of this Groundwater Committee on the management of the aquifer have not yet crystallized. The OMVS was established 50 years ago and is directly funded by the Member States. The VBA was established some 15 years ago and is financed by the Member States. The management of the Ramotswa Transboundary Aquifer is only recently formalized, VBA and LVBC have a relatively short history of formal cooperation, the ICPDR has a somewhat longer history but is also steered by EU rulings and the OMVS has a long history.

The analysis as such should therefore not be considered as an assessment of the functioning of the cooperation in the respective basins but rather as an indication. Generally, the longer the history, the better the cooperation is formalized and effective. But even when all key factors are present and the intention is there, in practice the cooperation may be troublesome. And sometimes cooperation is good but may not yet be formalized as the RAMOTSWA project shows.

Nevertheless, the overview and analysis provide important insights. One essential insight is that the human factor, the *how* is generally underestimated. Much of the literature on adaptation focuses on *what* needs to be done, like doing a risk assessment. Important factors, like leadership and urgency that are more difficult to specify and prescribe, have come out of the study on success factors for mainstreaming adaptation at city and national level. These factors become even more prominent in a transboundary situation where differences between culture, interests, approaches, etc. are larger.

The Enabling Environment framework provides good handles to design the process and the *how*. It describes how to develop an environment in which the *what*, the risk assessment, the design, prioritization and implementation of measures is enabled. The key factors as inventoried in this study enrich and complement this framework. The Enabling Environment framework has thus become a suitable tool to improve mainstreaming of climate change adaptation in water management.

This study also shows that a joint body has an important role to play in transboundary cooperation. Much of the key factors for the Enabling Environment that come from this study can be effectuated by a joint body. For instance, the joint body can take up the leadership in improving the mainstreaming and make arrangements to improve the enabling environment.





6. Recommendations

A list of key factors has been identified as success factors for mainstreaming climate change adaptation. The key factors have been arranged according to the Enabling Environment framework elements to provide a structure. It is recommended to use the key factors as a checklist to assess if the adaptation activities are embedded in a suitable environment that enables and promotes the activities. Table 8 provides an overview of the key factors with a short description of each factor.

The key factors are identified for a transboundary cooperation situation. They are also valid for the national and city level situation as, at all levels, there is a need for cooperation between different stakeholders and organizations.

It should be noted that the key factors describe the environment in which activities take place and do not describe the adaptation activities. The key factors can be implemented in different ways that also depend on the specific situation. Moreover, not all key factors need to be implemented to enable cooperation. And implementation of the key factors does not guarantee cooperation. Nevertheless, the more key factors are implemented and the better they are implemented, the better adaptation is mainstreamed and the more effective the cooperation can take place.

Element	Key factor	Description
Policy setting	Long-term vision or strategy	A view on what is considered as important in terms of socio-economic and ecological development in a 30 - 50 year timeframe and the actions that are needed to achieve this
	Flexible	Any decision is not carved in stone but can be reconsidered
	Innovative – experimentation	There is room for failure, for instance, through developing pilot-projects
	Change-oriented	Extrapolation of past trends is no longer valid and past approaches may therefore be no longer valid
	Coherent	The policies of all sectors is aligned and based on the same vision
	Holistic approach	The vision is comprehensive and is not limited to one specific sector
	Risk-based approach	Climate change risks are an important basis for the vision
	Joint problem definition and common understanding	The problems as identified are the result of an inclusive process
	Broad stakeholder involvement	All stakeholders are, as much as possible, involved
	IWRM	The principles of IWRM apply
	Benefits of cooperation	An explicit assessment of the benefits of cooperation between countries, organization and stakeholders is done
	Trust building and	All actors have had ample time to learn to understand
	collaborative learning	the situation and any information is freely accessible and not restricted
	Solid science base	Any information that is provided, for instance, climate change predictions, is based on scientific research
	Leadership	There is a clear, generally acknowledged promotor of the necessary processes

 Table 8 Description of the key factors for mainstreaming adaptation for the five elements of the Enabling Environment framework





Element	Key factor	Description
	Urgency	There is a joint understanding that there is a need for change
Legal setting	Appropriate legal framework	The legal framework supports the process and measures
	Adaptable/flexible	Legislation foresees regular evaluation and potential adaptation
	Roles and responsibilities	Legislation is in place that appoints the various roles and responsibilities
	Integrity and transparency	Processes and transactions are laid down in legislation and can be traced
	Equitable utilization	All water users have a similar right to use the resource
	Enforce legislation	Put sanctions on not applying legislation
Institutional setting	Horizontal and vertical communication and coordination Coalition	Communication and coordination is arranged between different levels from local to international and between different sectors/functions The possibility to align around a specific topic, for instance, climate change
	Capacity development – competence and expertise	Ensure capacity development for the people that are involved in the process, both inside and outside the organization, to ensure their competence and expertise
	Harmonized water resource management practices Purpose, objective and role	Water resource management practices are harmonized over the different organizations and countries Each institution has a clear purpose, objective and role
	Power and duties	in the process Each institution is mandated to perform its duties to fulfil their nurness
	Mediation	There is protocol for mediation in case of disagreements
Information management	Mutual access to information	All actors involved in the process have equal and unrestricted access to necessary information
	Monitor policy progress	Regular assessments on the degree that policies are implemented
	Broad communication and utilization of information	Active dissemination of information about the process
	Compatibility of data and data formats	Data is comprehensible independent of its source
	Harmonized scenarios and models	Scenarios and models from different institutions are comparable
Financial arrangements	Domestic budgetary resources Access to funds Effective implementation	Domestic funds are made available to ensure long-term continuation of the adaptation process There is access to donors to fund projects and programs Account is made of the implementation of the process, programs and projects





7. Acknowledgements

Many thanks to the people that reviewed the case study descriptions as well as the report...





8. Glossary

Adaptation is defined, in human systems, as the process of adjustment to actual or expected climate and its effects in order to moderate harm or take advantage of beneficial opportunities. In natural systems, adaptation is the process of adjustment to actual climate and its effects; human intervention may facilitate this (IPCC, 2022).

Integrated Water Resources Management (IWRM) is 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 (IPCC, 2018).

Joint body is any bilateral or multilateral commission or other appropriate institutional arrangement for cooperation between riparian countries (UNECE, 2018).

Mainstreaming refers to the integration of policies and measures that address climate change into development planning and sectoral decision-making.

Maladaptive actions (Maladaptation) are actions that may lead to increased risk of adverse climaterelated outcomes, including via increased GHG emissions, increased vulnerability to climate change, or diminished welfare, now or in the future. Maladaptation is usually an unintended consequence (IPCC, 2018).

Mitigation (of climate change) is a human intervention to reduce emissions or enhance the sinks of greenhouse gases.

Resilience is the capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure while also maintaining the capacity for adaptation, learning and transformation (IPCC, 2018).





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