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Gathering feedback on the draft publication "Good Practices and Lessons Learned in Transboundary Data-sharing"

Good Practices and Lessons Learned in Transboundary Data-sharing
(Second draft)

Summary and proposed action

At its ninth session (Geneva, 29 September – 1 October 2021) the Meeting of the Parties to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) entrusted the Working Group on Monitoring and Assessment to collect good practices and lessons learned in transboundary data-sharing and synthesize them in a publication, as part of the activities foreseen in the programme of work for 2022–2024 for *Programme area 2: Supporting monitoring, assessment and information sharing in transboundary basins* (ECE/MP.WAT/63/Add.1).

The Fourth joint meeting of the Working Groups on Integrated Water Resources Management (IWRM) and on Monitoring and Assessment (Tallinn, 28–30 June 2022) approved the outline of the new publication (ECE.MP.WAT/WG.1/2022/INF.3-ECE/MP.WAT/WG.2/2022/INF.3), including the template for case studies.

Subsequently, over 45 case studies for the new publication were received by the secretariat. In addition, several case studies were developed following the Regional Workshop on Monitoring, Assessment and Information Sharing in Transboundary Basins in Central Asia (Astana, 1–2 February 2023). Based on the case studies received, the secretariat with support of the lead expert and in consultation with lead Parties, has developed the draft.

During the Expert Meeting on Good Practices and Lessons Learned in Transboundary Data Exchange (Geneva, 18–19 April 2023), participants have provided feedback on the structure and text of the draft, and subsequently provided additional lessons learned and case studies to the secretariat for integration in the next draft of the publication. Several lessons learned were developed following the Workshop on Strengthening Legal and Institutional Arrangements for Transboundary Water Cooperation and Data Exchange (Beirut, 30-31 May 2023). In July 2023, the text was submitted for review to participants of the Expert Meeting and authors of case studies and subsequently revised based on the feedback received.

The present (second) draft of the publication is now submitted for review by the Working Group on Monitoring and Assessment. The Working Group is invited to:

(a) Provide feedback on the text, lessons learned, case studies and key messages;

(b) Agree on the next steps in the preparation of the publication, as well as the timeline for its finalization by the tenth session of the Meeting of the Parties to the Water Convention (Ljubljana, 23–25 October 2024).

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Annex 1: Matrix of lessons learned and case studies

Key messages

Good and informed water governance [1] and water management need timely, targeted, relevant, sufficient, and reliable data. Climate change and biodiversity loss [2] enhance the need for data and information. Data and information sharing provides a necessary common basis and is therefore a key instrument for effective transboundary water resource management and aquatic ecosystem management. See, e.g., Lesson 1, Lesson 38, Lesson 39, Lesson 40.

An enabling environment for data sharing, including policy, legal, institutional, informational and financial arrangements can substantially enhance transboundary cooperation. See, e.g., Lesson 2, Lesson 3, Lesson 4, Lesson 5, Lesson 6, Lesson 7, Lesson 8, Lesson 9, Lesson 41.

The available data and information on groundwater as well as sharing of the available data is generally limited. This may undermine the potential role groundwater can play in enhancing water security and resilience, especially in a transboundary setting. See Lesson 19.

To ensure cooperation and joint management of a basin, a common conceptual understanding of the functioning of the basin (location and volume of the water, origin of the water, flow direction and rate, water quality, aquatic biodiversity, influences on the water quantity and quality, different uses of the water, etc.) is needed. Information is also needed on planned measures and the pressures and pollution sources (e.g., from industrial, municipal, or agricultural or other sectors) to ensure an overview of the potential anthropogenic impacts in the transboundary watercourses. See, e.g., Lesson 10, Lesson 17, Lesson 18, Lesson 22, Lesson 23.

In developing or expanding a monitoring network, be pragmatic and focused. Start with the most important aspects and most relevant indicators in your basin. Gain routine and experience from the monitoring and after that extend the scope, depending on staff and budget capacities. See, e.g., Lesson 13, Lesson 14, Lesson 15, Lesson 25.

A technical approach for data and information collection and sharing is necessary, but it is not sufficient. Strong political will is needed in political decisions, like agreements and protocols but also in making data open, for stability and solidarity between the riparian countries. There is a need for leadership to initiate and continue cooperation, also in data and information sharing. RBOs can support such a leadership role. The inclusion of target 6.5, supported by indicator 6.5.2, in the SDGs may help consolidate political will. See, e.g., Lesson 16, Lesson 33, Lesson 34.

Water management requires cooperation with different sectors. All stakeholders should organize themselves around the issues at stake and start interacting. Different stakeholders have different values, different biases, different preferences, different backgrounds and cultural perspectives. True interaction can for that reason only be achieved when the actors are aware of the existence of these different perspectives and are convinced of the value of joint efforts in bringing knowledge together. See, e.g., Lesson 11, Lesson 12, Lesson 35, Lesson 36, Lesson 42.

Different approaches and techniques exist for collecting and disseminating data. Also, models can support analyzing and assessing data. Working together at different levels and with different disciplines can help to augment the value of the data collected. This nevertheless requires accessibility and comparability of the data as well as regular evaluation of the monitoring system. See, e.g., Lesson 20, Lesson 21, Lesson 26, Lesson 27, Lesson 28, Lesson 29, Lesson 30, Lesson 31, Lesson 32, Lesson 37, Lesson 43.

To be able to take timely measures, it is important that data and information about possible floods, accidental pollution and potential droughts is shared among neighboring countries. Developing an transboundary early warning system requires timely data sharing with all the elements as described above as well as proper procedures to ensure that the right information reaches the right institutions and people at the right time. See Lesson 24.

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[1] 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 (http://www.oecd.org/governance/oecd-principles-on-water-governance.htm).

[2] https://www.ipcc.ch/site/assets/uploads/2021/07/IPBES_IPCC_WR_12_2020.pdf and https://www.ipcc.ch/report/ar6/wg2/chapter/ccp1/

Regular and planned monitoring and data-sharing brings numerous benefits. Some of the key benefits as identified by many countries are:

- It enables an assessment of the current state of the whole basin and trends over time that allows to develop a management strategy that accounts for the particulars of the basin;
- It enables assessing the impacts of climate change on the water resources and the anthropogenic impacts on biodiversity, both locally and at the basin level;
- It enables identifying actual and emerging problems and impacts of human pressures in the basin;
- It enables an estimation of the flux of substances from rivers or groundwater to oceans;
- It enables a common understanding among the riparian countries of the water management issues at hand and allows development of water management measures that can strengthen tackling the various needs of water users, including ecosystems, in the basin;
- It supports increased transparency and mutual understanding and, with that, building of trust between transboundary partners;
- It enables a rapid assessment and early warning of the impacts of an incident (e.g., flood, drought, chemical spill) on a water body and its surroundings;
- It enables informed decision-making for the development and implementation of water management strategies and plans, and evaluation of the effectiveness and efficiency of management and remediation activities.

1. Introduction

1.1. Background and objectives of the document

Data and information are key to informed management of water resources. This holds even more true in times of increasing water stress because of climate change and demographic and economic growth. The Water and Climate Coalition in its Action Plan states this as follows: *"Data and information are the foundation of climate smart sustainable development. We need data to understand how climate change is affecting our water systems; to understand where, how much, and in what quality water is and will be available. We need information to know where and how our actions can best support our access to the precious resource and protect us from water hazards and disasters."* [3]

When a basin [4] is shared between two or more countries, comparable and open data and information is necessary as a common basis for informed decision-making. Moreover, data and information sharing play an important role in building trust, thus facilitating cooperation and conflict avoidance. This has been recognized in the SDG indicator 6.5.2 which includes regular exchange of information between riparian countries among the operationality criteria for arrangements on water cooperation.

There is, therefore, an urgent need for well-organized monitoring programs that provide the data and information for accurate assessments of the status of water resources and aquatic ecosystems and the magnitude of water quality and quantity problems at the basin and sub-basin levels.

To support the development of monitoring programs for transboundary basins, the Working Group on Monitoring and Assessment under the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) developed the Strategies for Monitoring and Assessment of Transboundary Rivers, Lakes and Groundwaters in 2006 and updated these Strategies in 2023 (Updated Strategies for Monitoring and Assessment of Transboundary Rivers, Lakes and Groundwaters). [5] To support countries in applying the Updated Strategies and establishing data exchange in transboundary basins, the Working Group on Monitoring and Assessment collected case studies that can illustrate examples of how monitoring programs are run and how sharing of data can be introduced and enhanced in

[3] https://www.water-climate-coalition.org/wcc/wp-content/uploads/2022/06/Endorsed_Action_plan.pdf

[4] In this report, 'basin' refers to any body of water, including groundwater bodies, aquifers, lakes and rivers.

[5] https://unece.org/sites/default/files/2023-01/ECE_MP.WAT_70_ENG.pdf

transboundary basins in different parts of the world. The focus of this collection of lessons learned and good practices is on the sharing of data between the riparian countries.

This publication compiles, analyses and disseminates experiences, and thereby demonstrates and illustrates important steps and lessons learned as well as good practices to consider when developing a monitoring program for water management in a transboundary context and establishing data and information sharing in transboundary basins. As the lessons only highlight specific elements, they should be considered in the broader context of the Updated Strategies. Moreover, not all lessons apply to all situations.

A total of 62 case studies were collected and formatted into the publication from around the world: 16 from Africa, 12 from Asia, 23 from Europe, 3 from North America and 8 from South America. The purpose of the case studies is to illustrate real life examples, including both the difficulties and challenges countries face and solutions and ways of organization that countries and joint bodies have found useful. Several case studies were developed following the Regional Workshop on Monitoring, Assessment and Information Sharing in Transboundary Basins in Central Asia (organized by IWAC in cooperation with GIZ and the Water Convention secretariat in Astana, 1–2 February 2023), and several lessons learned were developed following the Workshop on Strengthening Legal and Institutional Arrangements for Transboundary Water Cooperation and Data Exchange (organized by UNESCWA in cooperation with UNECE and UNESCO in Beirut, 30-31 May 2023).

1.2. Target audience

The target audience of this publication includes all those working on monitoring programs and sharing of data and information in transboundary, [6] but also national, basins, including joint bodies, such as basin commissions and other institutions for transboundary cooperation, as well as the national representatives in such joint bodies; developers of monitoring strategies, especially in transboundary basins; decision makers; specialists working on monitoring and assessment in ministries; and other authorities, scientists and Non-Governmental Organizations (NGOs).

1.3. Structure of the document

This publication describes selected important lessons from experiences specifically in sharing data and information from monitoring programs in a transboundary context and illustrates these with examples from all over the world. It is not intended as a handbook as it does not provide detailed instructions related to the development of monitoring programs or sharing of data and information. Instead, it aims to provide food for thought and inspire the development of monitoring programs and sharing of data and information.

A lesson learned in this publication is described as a recommendation about a certain concept or approach that has proven to be beneficial or effective as derived from practical experience in a specific situation. A good practice (see case studies throughout the publication) is a case situation in which certain concepts or approaches proved to be beneficial or effective in a particular context. Each case study highlights one or more lessons learned, as indicated in each case study. It should be noted that the recommendations presented in the lessons are neither meant to be comprehensive, nor prescriptive or universally applicable but rather supportive and based on on-the-ground experience and may not be valid in all situations. The case studies provide partial information and are illustrations with the purpose to inspire.

The publication is structured according to the logical steps in data-sharing as described in the Updated Strategies for Monitoring and Assessment of Transboundary Rivers, Lakes and Groundwaters [5], starting with the overall monitoring and assessment context. Subsequently, the various elements of developing data-sharing are described, including the set up in which the data-sharing takes place, the policy, legal and institutional aspects of the data and information sharing, the different types of data and information that is shared, different aspects of harmonization and quality assurance of the data and information, how data is stored and managed, why and how data and information are reported, the impacts and benefits of data-sharing, and the main difficulties and challenges of data and information sharing.

[6] Transboundary in this publication refers to crossing national boundaries. Basins can also cross sub-national jurisdictions, like state boundaries or province boundaries. Also at the national level, sharing of data between jurisdictions is needed.

Annex 1 Lessons Learned vs Case Studies, contains a list of each lesson learned and case study as well as a matrix showcasing the relations of each case study to the different lessons learned.

2. The monitoring and assessment context

In the pursuit of sustainable integrated water resources management, it is important to find common ground and emphasize the similarities instead of the differences between institutions and countries. Sharing of information helps to find common ground. Political support is needed to develop and maintain monitoring systems as well as sharing the resulting data and information. Such support can be laid down in formal agreements or informal support for cooperation.

Mandates for monitoring and sharing of data should be accompanied by adequate funding. Sustainable financing of monitoring systems is crucial to be able to identify trends and changes over time and therefore to single out the effects of policies and measures. A step-by-step approach in developing and extending monitoring and sharing of information is recommended to enable a process of transparency and trust-building. Experiences show that joint study trips, workshops, and discussions bring the cooperating people closer together within the countries as well as across transboundary basins.

The basin forms a natural unit for integrated water resources management in which rivers, lakes and groundwaters interact with other ecosystems. The whole basin should therefore be considered when developing a monitoring system.

Groundwater monitoring is often more complex than surface water monitoring. Groundwater systems are three-dimensional, often complex environments, with limited observation points (springs, wells), whose assessment usually requires expensive and long-term efforts. Therefore, relevant experts, like hydrogeologists, should be engaged on a permanent basis in the structures in charge of transboundary cooperation (e.g., RBOs, joint bodies).

Lesson 1. Use basin management planning as a trigger to develop monitoring and data-sharing systems.

Countries that develop agreements on cooperation in river basin management planning often run into the problem that the data and information base is weak. Setting up the cooperation therefore often involves developing monitoring and data-sharing systems.

Case study 1. Sharing of information between Chile and Argentina

Lessons learned covered in this case study: Lesson 1, Lesson 10, Lesson 18, Lesson 28

Chile and Argentina share information on the transboundary basins Río Valdivia, Río Puelo and Río Baker. In 1991, Chile and Argentina signed the Environmental Treaty and the Additional Specific Protocol on Shared Water Resources. The Protocol establishes a Working Group within the framework of the Environment Subcommittee, a body that in turn is part of the Chilean-Argentine Binational Commission (Art. 12 of the 1984 Peace and Friendship Treaty).

Article III of the Treaty, on "Means", provides the following: "Sharing of technical-scientific information, documentation and joint research".

For its part, Article 8 of the Protocol indicates: "(...) the execution of the actions and programs referred to in this Protocol will be carried out, mainly, through:

a) Sharing of legal, institutional, technical-scientific information, documentation and research.

b) Organization of seminars, symposiums and bilateral meetings of scientists, technicians and experts."

On the other hand, in Article 5, the Protocol establishes that the General Use Plans (PGU) are the management instrument agreed between the countries for a shared and integrated management of water resources.

Each country delivers the information prepared by its agencies and institutions, within the framework of its annual budget item. There are no financial or budgetary obligations between the countries.

In 2019, both countries shared spatial information including: political-administrative limits, the delimitation of hydrographic basins, basin hydrography, location of glaciers and protected natural areas; as well as the location of meteorological, fluviometric, water quality and glaciological stations.

The information shared between both countries is intended to build an atlas of the basins shared between Chile and Argentina and, specifically, to have fundamental and basic information to reach an agreement on a General Utilization Plan (PGU) for each prioritized basin.

Source: Case study provided by Macarena Bahamondes, The National Directorate of State Borders and Limits (DIFROL) of Chile, 2022

Case study 2. Governance and management of the Stampriet Transboundary Aquifer System (STAS)

Lessons learned covered in this case study: Lesson 1, Lesson 8, Lesson 13, Lesson 19, Lesson 31

The Stampriet Transboundary Aquifer System (STAS) lies entirely within the Orange-Senqu River Basin, in an area shared by Botswana, South Africa and Namibia. In 2017, the countries sharing the STAS agreed to establish a Multi-Country Cooperation Mechanism (MCCM) for the joint governance and management of the aquifer, nested within the structure of the existing Orange-Senqu River Commission (ORASECOM). The STAS MCCM was created in the framework of the project Governance of Groundwater Resources in Transboundary Aquifers (GGRETA), implemented by UNESCO-IHP, in close partnership with national counterparts and with support of the Swiss Agency for Development and Cooperation (SDC). The MCCM is composed of three National Focal Points per riparian country: one hydrogeology/model focal joint, one legal/institutional focal point, and one gender focal point. The focal points assist and report to ORASECOM's Groundwater Hydrology Committee (GWHC), which in turn oversees and advises the Technical Task Team of ORASECOM on the development and management of groundwater resources of the Orange-Senqu River Basin. The nesting of the MCCM in ORASECOM's GWHC illustrates the feasibility and importance of African RBOs as institutions providing an enabling institutional structure to guide cooperation on groundwater resources management. The Stampriet aquifer has since been a catalyst for the establishment of transboundary aquifer coordination mechanisms in the southern Africa region.

The long-term vision of Botswana, Namibia and South Africa is to achieve permanent institutionalized cooperation where the function of the MCCM is joint strategizing and advising the countries on the management of the aquifer resources in the region. To facilitate this, the GGRETA project supported the co-development of a STAS Wide Strategic Action Plan (SAP) in 2021. The SAP proposes projects and management actions necessary to address the identified priority problems to achieve the aquifers' sustainability goals. Priority activities within the SAP include setting up a groundwater level monitoring network to assess the status of the aquifer and to improve groundwater data-sharing by the Member States. Furthermore, the plan identifies priority monitoring sites, and suggests a set of objectives of transboundary monitoring of groundwater levels and groundwater quality. The data aims to provide input to the existing ORASECOM Water Information System (WIS). [7] The data is also part of the GGRETA Information Management System. [8]

The project also delivered an assessment to support the improvement of data-sharing and monitoring frameworks in ORASECOM with a focus on the STAS. The assessment includes a report on the status and trends of groundwater resources in the aquifer, updating the inventory of groundwater data available as of 2022. [9] Furthermore, it provides a baseline and a template for future annual reporting periods by the GWHC, identifying gaps to be filled towards improved monitoring. The national governmental institutions who acted as focal points during GGRETA are also key stakeholders to lead the continuation of efforts in data-sharing and monitoring: the Ministry of Land Management, the Water and Sanitation Services of Botswana, the Ministry of Agriculture, Water and Land Reform of Namibia and the Department of Water and Sanitation of South Africa.

[7] https://wis.orasecom.org/

[8] https://www.un-igrac.org/resource/ggreta-information-management-system-ims

[9] https://unesdoc.unesco.org/ark:/48223/pf0000245265.locale=en

Source: Case study prepared by Karen Villholth, Water Cycle Innovation based on reports by UNESCO-IHP, 2023

Lesson 2. Ensure political support for the monitoring and data-sharing system.

Political will is an important prerequisite for cooperation that can be promoted by incorporating water as an element of regional cooperation and integration. Political support is of great importance for a monitoring system as it requires a longer-term commitment. Involving policymakers in guiding the set-up of the system and portraying the benefits of data and information at basin level will contribute to building political support. A policy for sharing data and information and a resulting monitoring system that generates sound information can subsequently provide a solid basis for negotiations among riparian countries.

Case study 3. Ganga/Ganges Water Sharing Treaty

Lessons learned covered in this case study: Lesson 2, Lesson 35

The Ganga/Ganges River is shared between Bangladesh and India. In Bangladesh, the Joint Rivers Commission is responsible for the data-sharing, in India the Central Water Commission is the responsible institution. The governments of both countries signed the "Ganges Water Sharing Treaty, 1996" [10] on 12 December 1996 for a period of 30 years. The treaty deals with the sharing of water in the dry season between 1 January and 31 May, thus providing support to the respective commissions in both countries.

The Joint Rivers Commission, Bangladesh is responsible for monitoring and sharing of the Ganga/Ganges Waters at the Farakka barrage in India. Monitoring takes place at the Hardinge Bridge in Bangladesh. All expenses related to data and information sharing is borne by the respective governments. Data that is shared includes:

- Total observed flow
- Flow released to Bangladesh
- Flow released to India
- Water level

Data are collected by a joint observation team formed of team members from both countries. Data is shared every year in the form of a report.

In Bangladesh, the data is stored in the Joint Rivers Commission Office. The data is open for public through a website [11] and an annual report is prepared every year. Decision makers are informed about the recommendations of the report.

Source: Case study provided by Md. Riadur Rahman, Joint Rivers Commission (Bangladesh), 2022

Lesson 3. Embrace an open data approach to water data access.

"Open data is data that is openly accessible, exploitable, editable and shared by anyone for any purpose". [12] International experience shows that the more "open" data is, the more economic and social benefit is created. It is therefore recommended that an open data approach is considered when establishing access arrangements for water data. [13]

[10] http://www.ssvk.org/koshi/reports/treaty_on_farakka_india_bangladesh_4_ganga_river_water.pdf

[11] http://jrcb.gov.bd

[12] https://en.wikipedia.org/wiki/Open_data

[13] https://en.unesco.org/science-sustainable-future/open-science/recommendation, http://www.bom.gov.au/water/about/publications/document/Good-Practice-Guidelines-for-Water-Data-Management-Policy.pdf and https://public.wmo.int/en/our-mandate/what-we-do/observations/Unified-WMO-Data-Policy-Resolution

Case study 4. The Amazon Regional Observatory

Lessons learned covered in this case study: Lesson 3, Lesson 23, Lesson 24, Lesson 31

The Amazon River Basin is the largest basin in the world, covering more than 6 million km^2, and is shared between Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname, and Venezuela. The eight Amazon countries are members of the Amazon Cooperation Treaty Organization [14] (ACTO), which was created in 1998 as a permanent forum for cooperation, exchange and information, based on the Amazon Cooperation Treaty, signed in 1978. Since 2002, the Organization has a Permanent Secretariat located in Brasilia, Brazil. A Strategic Action Program for the Integrated Management of Water Resources in the Amazon Basin (SAP) was developed and adopted by the riparian states in 2017.

The SAP recommended the establishment of regional monitoring networks incorporating hydrometeorological, water quality, ETA (Erosion, Transport and Sedimentation) and groundwater elements as well as an Integrated Water Resources Information System, strengthening information exchange mechanism between the national institutions responsible for the management of water resources. In 2021, with a broad vision of regional integration of information, ACTO inaugurated the Amazon Regional Observatory (ORA), as an information reference center and permanent virtual forum that facilitates the flow and exchange of information on the Amazon. The Observatory hosts the *Amazon Hydrological Network*, which monitors the water balance and exchange of water between the countries based on 343 monitoring stations, and the *Regional Network for Water Quality Monitoring*, for which the countries have agreed to exchange information on the water quality parameters defined in relation to the SDG indicator 6.3.2.

Currently, data-sharing in the Amazon is done with the budget of the Permanent Secretariat of the Amazon Cooperation Treaty Organization (PS-ACTO) and resources of the "Amazon Project - regional action in the area of water resources" (South-South cooperation with the National Agency for Water and Basic Sanitation of Brazil (ANA) and the Brazilian Cooperation Agency (ABC)). Data includes hydrometeorological monitoring of river levels and flows, water quality monitoring, and critical situations (floods and droughts). Collection of the data is done by countries' hydrological and water quality monitoring networks. A diagnosis of the hydrological and water quality monitoring protocols in riparian countries was done and a proposal for a standardized protocol for the Amazon Basin is being proposed.

The data is shared by online access to the information systems of the riparian countries and the Amazon Regional Observatory of the PS-ACTO. Hydrological data is shared every hour. The water quality data is shared every 7 days. The data is stored in the joint database of the Amazon Regional Observatory of the PS-ACTO and is accessible to the public on the website of the Amazon Regional Observatory. [15] The data can be downloaded by API (Application Programming Interface) in Excel, JPEG and CSV format.

A Water Resources Situation Room was implemented in the PS-ACTO and will develop drought and flood early warning bulletins and reports for decision makers and the public. This regional Situation Room will be connected to a network of National Water Situation Rooms, to be established under the on-going Amazon SAP Implementation Project (ACTO/UNEP/GEF).

The first Water Quality Report of the Amazon Basin was launched by ACTO in a side event of the United Nations Water Conference in March 2023. The Report shows the main pollution sources and their impact on water bodies.

The operation and expansion of the hydrological and water quality monitoring networks depends on the institutional strengthening of national monitoring and information systems and on a long-term financial support, considering the costs of monitoring and the countries' budget constraints.

[14] http://otca.org/en/

[15] https://oraotca.org

Amazon Networks Module

ACTO Water Situation Room

Source: Case study provided by Maria Apostolova, The Amazon Cooperation Treaty Organization (ACTO), 2023

Case study 5. Open data access in South Africa and The Gambia

Lessons learned covered in this case study: Lesson 3, Lesson 19, Lesson 31

South Africa is a water-stressed country where groundwater contributes significantly to rural and urban water supply, as well as irrigation. An estimated 80,000 to 100,000 boreholes are drilled each year. To manage groundwater resources efficiently and sustainably, the Department of Water and Sanitation collects a large amount of data of various types, such as borehole data and groundwater monitoring data. The groundwater level monitoring network comprises approximately 1,800 observation wells that are monitored on different monitoring frequencies.

Since June 2010, groundwater data is made available for download in the National Groundwater Archive (NGA). [16] The NGA is an online, centralized database where everyone can register, for free, to access groundwater data. The NGA is a main component of the National Groundwater Information System, a responsibility of the Department of Water and Sanitation set forth by the National Water Act, established in 1998.

[16] https://www.dws.gov.za/NGANet/

The database currently comprises of 293,100 information points, such as boreholes, dug wells, seepage ponds, springs, etc. Data can be captured and edited from the regional offices of the Department of Water Sanitation, and by several registered partner institutions. Several filters are available to browse through the desired datasets. Data like monitoring water level data can also be visualized in charts.

Currently, on average 500 users consult the NGA every month and the number grows continuously. Data is used for a broad range of applications in water management and environmental protection, by public institutions as well as the private sector. It is particularly helpful for siting new wells. It has also proved instrumental for the assessment of river basins and aquifers shared with neighboring countries. The management of these transboundary resources requires groundwater and other water data to be shared between riparian states. The NGA has proved particularly useful in this regard and may inspire similar initiatives in neighboring countries.

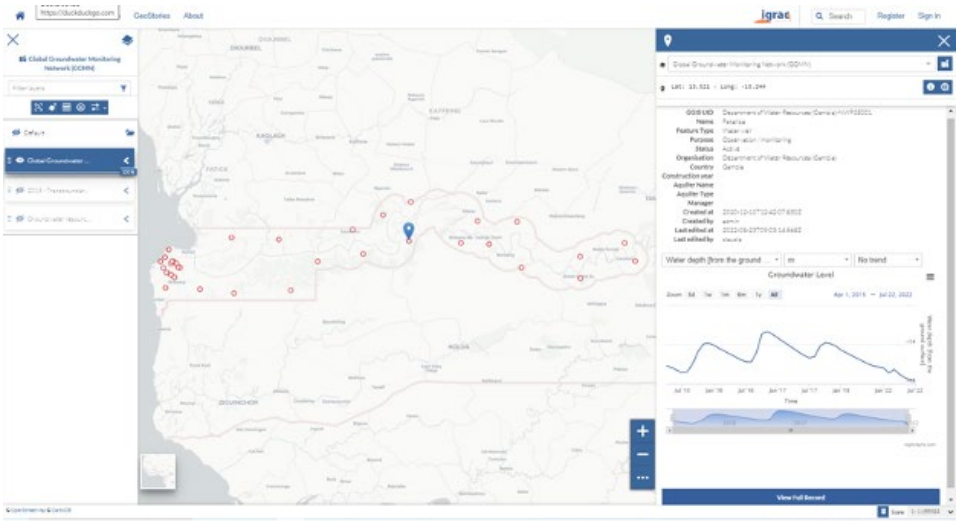
The Gambia is a small West African country of 10,700 km^2, with an estimated population of 2.6 million. The country is surrounded by Senegal. As its name indicates, it is located on the lower stretch of the Gambia River. In the Gambia, the Gambia River is nearly at sea level, which makes it vulnerable to seawater intrusion. Water is saline up to 250 km from the mouth of the river, which corresponds to the western half of the country, where most of the people live.

The salinity of surface water makes the Gambia particularly dependent on fresh groundwater, which is found at shallow depth throughout the country. Sustainable groundwater management is therefore a priority, and active measures are required to prevent anthropogenic contamination, over-abstraction or seawater intrusion into the aquifers.

Since 2014, the Department of Water Resources of the Gambia operates a groundwater monitoring network of about 35-40 observation boreholes. Most of the observation boreholes are equipped with automatic data loggers. Nearly half of the monitoring boreholes are concentrated in the capital city area, where the population density and industrial activity is the highest, while the rest are equally distributed eastward at 35 km distance throughout the north and south bank of the country.

Groundwater level data, groundwater quality data and borehole data are collected and managed by different units, across different ministries. The same goes for surface water data and meteorological data. Data-sharing is therefore necessary for efficient water management. However, the plan to set up a national information system has not yet materialized, and data-sharing remains a challenge.

To move forward, the division in charge of the groundwater monitoring network has decided to share the data in the GGIS, the Global Groundwater Information System, [17] an online platform operated by International Groundwater Resources Assessment Centre (IGRAC) where hydrogeological maps, borehole data and groundwater monitoring data can be shared and made accessible to all, for free. The groundwater monitoring data from the Gambia has been accessible since 2018.



[17] https://ggis.un-igrac.org/

Source: Case study provided by Arnaud Sterckx, International Groundwater Resources Assessment Centre (IGRAC), 2023

Lesson 4. Ensure clear mandates for data-sharing at bilateral or basin level.

In many basins, agreements and legal frameworks for sharing of data and information are lacking. The subsequent formal structure is absent, which makes sharing of data and information difficult. The basic obligation of riparian countries to share data and information needs to be stipulated in intergovernmental agreements on transboundary water cooperation at bilateral and/or basin level to provide the mandate for national institutions to sharing information and for joint bodies to collect, process and disseminate such information. The sharing of data and information can be further specified in other technical documents such as monitoring programs, technical regulations on information or data-sharing, and statutes and regulations of joint bodies or their working groups. Agreements should be developed in such a way that they can be complimented by more detailed technical documents or protocols. Also, agreements should not be a limiting factor to the level of cooperation.

Case study 6. Legal mandates for data and information sharing in the Aral Sea basin

Lessons learned covered in this case study: Lesson 2, Lesson 4, Lesson 13

For over 30 years, five Central Asian states of the Aral Sea basin (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan) cooperate in the framework of the regional organization - International Fund for Saving the Aral Sea, and its institutions – the Interstate Commission for Water Coordination of Central Asia (ICWC) and the Interstate Commission for Sustainable Development of Central Asia (ICSD). Main institutions for data-sharing are the Basin Water Management Organizations “Amu Darya” and “Syr Darya” and the Scientific and Information Centre of ICWC (SIC ICWC). [18]

Provisions on information sharing have been included in the constituent documents of regional organizations such as the intergovernmental Agreement on Cooperation in the Field of Joint Management on Utilization and Protection of Water Resources from Interstate Sources (1992), relating to both surface- and groundwater, and the Statute of the ICWC (1992, revised in 2008), both signed by the five states. They were further detailed through decisions of ICWC. In 2005, the ICWC adopted Temporary Rules for the Use of the Regional Information System on Water and Land Resources of the Aral Sea Basin. In 2014 ICWC approved the Concept Document on the Development of an Information Network on Water Management in Central Asia. The latter describes a step-by-step approach to develop databases and information systems at the national, basin, and regional levels, while relying on existing resources and infrastructure.

Source: Case study provided by Dinara Ziganshina, Scientific Information Center of the Interstate Commission for Water Coordination in Central Asia (SIC-ICWC), 2022

Case study 7. Buzi, Pungwe and Save Basins: The Bupusa Data Sharing Protocol

Lessons learned covered in this case study: Lesson 2, Lesson 4

The Mozambique-Zimbabwe Joint Water Commission is mandated to arrange sharing of data and information on water resources between the two countries. The frequency and type as well as quality of data to be shared is not well defined in the Joint Water Commission Agreement. However, the two countries have signed Water Sharing Agreements on the Pungwe (2016), Buzi River (2019) and now they are finalizing the Save Water Sharing Agreement. In these agreements, there is an annex on data-sharing. Further to that, the two countries, with support from the GEF BUPUSA project, have developed a data-sharing protocol called ‘Rules and Procedures between the Republic of Zimbabwe and the Republic of Mozambique on the Sharing of Data and Information Related to the Development and Management of the Buzi, Pungwe and Save Watercourses’. The data-sharing protocol has been approved by the Joint

[18] http://icwc-aral.uz

Water Commission but will come into force once it has been signed by the Ministers responsible for water from both countries.

The responsible institution for the Bupusa Data Sharing Protocol is the Mozambique Zimbabwe Joint Water Commission with support from the Regional Administration of Southern Waters (ARA Sul, Administração Regional de Águas do Sul) and the Zimbabwe National Water Authority.

Currently the responsibility of financing data collection lies with the member states. In Zimbabwe there is cost recovery for data by selling data to the public as well as other institutions. This however does not apply where data is being shared by riparian countries. In Mozambique there is an MoU between the water institutions and the meteorological institutions for free access to data. Hydrological/water quality data is available for free.

Source: Case study provided by Loreen Katiyo, Global Water Partnership Southern Africa (GWPSA), 2022

Lesson 5. In the absence of a formal agreement, informal cooperation can still take place.

Cooperation is necessary for proper management, but it is not always necessary to have a formal agreement. For example, experts and the academia from riparian countries can make steps in sharing data and information. Still, a formal agreement provides better guarantees for data-sharing than informal expert relations.

Case study 8. Informal cooperation on transboundary aquifers along the Mexico-U.S. border

Lessons learned covered in this case study: Lesson 5, Lesson 7, Lesson 10, Lesson 19, Lesson 31, Lesson 34

The Binational Groundwater Task Force (BGTF) [19] is part of the Permanent Forum of Binational Waters between Mexico and the United States. The BGTF is composed of members from both countries. There is no agreement. This is an informal effort of experts and academics working together. There is no mandate, and everything is discussed and agreed upon by members of the BGTF on a voluntary basis. Also, there is no financial arrangement or money committed to this effort yet. Everything has been done on a voluntary basis. Potential projects have been attracted and funding might come later. On average, the BGTF meets virtually once a month.

Initially, data is shared by direct exchange only among members of the BGTF network. Data and existing information are then standardized, and inconsistencies removed. The information and knowledge generated with this framework will then be published as white papers, scientific papers, and synthetic plain language reports, mainly addressing decision-makers. There is no protocol on the timing; the sharing is based on activities assigned or required by the members and the expected outcomes. Data is stored in the database of the Permanent Forum of Binational Waters by members of the BGTF network.

The cooperation is mainly intended to provide a consistent quantitative framework for identifying transboundary groundwater issues based on shared indicators, a factual set of baseline conditions and a clear set of objectives that are accepted by all major stakeholders, governmental and non-governmental entities along the Mexico-US border, to guide diplomatic discussions. The BGTF believes that enabling data and information sharing will build trust.

Data and information include:

- Monitoring data of the water quantity and quality of transboundary groundwater;
- Information on best available technology;

[19] https://www.binationalwaters.org/programs-and-initiatives/binational-waters-task-force/

- Results of relevant research and development;
- National regulations;
- Hydrogeological characteristics of transboundary aquifers (TBAs);
- Identification of potential common TBA issues such as:
    - Main aquifer stressors, and/or transboundary effects, driven by demographic growth, economic integration, hydro-social conflicts, differences in governance regimes, and climate change.
    - Intensive use, unsustainable water-use practices and overexploitation of groundwater in the Mexico/US TBAs.
    - Different water-management and governance approaches.
    - Increasing water threats and conditions for water conflicts.
    - Design of specific metrics to identify the common TBA issues listed above.

The BGTF plans to provide all the analyses with processed data and generated information to the members of the Permanent Forum of Binational Waters, International Boundary Waters Commission (IBWC), Comisión Internacional de Limites y Agua (CILA) and states and federal governments as policy briefs, data production reports, joint publications, etc. Information is made publicly available once it is integrated and reported properly.

Source: Case study provided by Alfonso Rivera and Rosario Sanchez, International Association of Hydrogeologists' Transboundary Aquifers Commission, 2022

Case study 9. Informal data and information sharing in the Tuli Karoo Aquifer

Lessons learned covered in this case study: Lesson 5, Lesson 7, Lesson 19, Lesson 39

The Tuli Karoo Aquifer is shared between the three states of Botswana, South Africa, and Zimbabwe, for which the institutions responsible for monitoring and data-sharing are the national entities of the Department of Water and Sanitation - Botswana, the Department of Water and Sanitation -South Africa, and the Zimbabwe National Water Authority, respectively. There is no joint body overseeing cooperation and management associated with the aquifer, though the Groundwater Committee of Limpopo Watercourse Commission (LIMCOM) plays a significant role in coordinating activities on transboundary aquifers in the Limpopo River Basin at large, in particular through the Southern African Development Community Groundwater Management Institute (SADC-GMI). In the basin, three transboundary aquifers have been identified, the Ramotswa Aquifer (see Case study 61), the Tuli Karoo, and the Limpopo Aquifer Basin.

The area is semi-arid and water availability, particularly surface water is variable and scarce. Groundwater is thus a primary source of water for domestic and agricultural use for the largely rural communities. With growing climate impacts such as protracted droughts, greater use of groundwater is likely, which will require more concerted management action across the borders. Adequate data that informs decisionmakers on water availability is an important prerequisite for the sustainable management of the shared aquifer. An extensive study on the shared aquifer was undertaken, bringing together water officials from the three countries to discuss on the potential of the aquifer to provide water and food security for the couple of millions that depend on it. [20]

There is currently no formal agreement in place between the countries on data-sharing. However, within the scope of the project Conjunctive Surface-Groundwater Management of SADC's Shared Waters: Generating Principles through Fit-for-Purpose Practice, funded by USAID and led by International Water Management Institute (IWMI), there was consensus on a pilot installing data loggers and informally sharing data on groundwater, importantly water levels, among the countries. [21] The equipment was

[20] https://conjunctivecooperation.iwmi.org/wp-content/uploads/sites/38/2021/06/TuliKarooTDA-compressed.pdf

[21] https://conjunctivecooperation.iwmi.org/wp-content/uploads/sites/38/2022/02/Groundwater-monitoring-in-the-Tuli-Karoo-Transboundary-Aquifer-Area.pdf

provided by UIT GmbH (Dresden, Germany), a private sector specialist in monitoring and telemetry. The online system and data loggers were purchased through project finance.

During project implementation, data was collected through existing borehole infrastructure (monitoring boreholes). A study on designing a strategic transboundary aquifer monitoring system of wells was conducted by IWMI, indicating the ideal need for 58 monitoring boreholes to enable meaningful information. In 2020, in total four existing boreholes in Botswana and South Africa were equipped with dataloggers and sensors for pressure, temperature and electrical conductivity (CTD-GPRS system), where pressure is automatically converted to water level. [22] Data transmission is wireless and real time (daily, with half hour resolution) using cloud-based telemetry, with data accessible via a web browser on a computer or smartphone. [23] Access is limited to government officials, and data is not public.

Currently, the system is out of use, but there is potential for it to be revitalized and expanded according to the design specifications. This would require both financial and technical commitment from the three countries to sustain the system and to generate the required data that respond to specific needs. As this was a project-funded pilot, there was no financial obligation on the countries. More concrete cooperative arrangements need to be put in place that will support the viability of the monitoring system such as ensuring the maintenance of the monitoring boreholes and joint data analysis. Also, arrangements should be made to migrate the system to the LIMCOM or SADC-GMI data/information platforms.

Source: Case study provided by Karen Villholth, Water Cycle Innovation based on reports by the International Water Management Institute (IWMI), 2023

Lesson 6. Ensure adequate and continuous financing for monitoring and data-sharing.

Regular and long-term monitoring is important for trend analysis, climate change assessment, biodiversity changes and for aquifer monitoring. Monitoring therefore requires long-term commitment and financing to be able to develop a good joint understanding of the water situation and to discover trends. One approach is to develop a joint monitoring system including the sharing of the data, with financing from different sources including riparian states and donors. Especially the improvement of a monitoring system and development of new methods or hardware can be supported from external sources. The overall running of the monitoring system is most secure when it is financed from domestic sources. Instead of a joint monitoring system, data from the respective national monitoring systems can be shared.

Case study 10. Financing sharing of data in the Sava River Basin

Lessons learned covered in this case study: Lesson 4, Lesson 6, Lesson 24

The Sava River Basin is shared between Slovenia, Croatia, Bosnia and Herzegovina, Serbia, Montenegro, and a small part of northern Albania. Cooperation takes place in accordance with the Framework Agreement on the Sava River Basin (FASRB) [24] and implementation is coordinated by the International Sava River Basin Commission (ISRBC). [25] The permanent Secretariat serves as its executive body. The Parties to the FASRB are Slovenia, Croatia, Bosnia and Herzegovina, and Serbia, while Montenegro cooperates based on the Memorandum of Understanding between ISRBC and Montenegro. Among other legal frameworks, the 'Policy on the Exchange of Hydrological and Meteorological Data and Information in

[22] https://conjunctivecooperation.iwmi.org/wp-content/uploads/sites/38/2021/03/GroundwaterMonitoringTuliKarooFINAL.pdf

[23] https://agrilinks.org/post/achieving-sustainable-resource-use-measuring-what-you-manage-groundwater-monitoring-shared-tuli

[24] https://www.savacommission.org/UserDocsImages/05_documents_publications/basic_documents/fasrb.pdf

[25] https://www.savacommission.org/sava-commision/structure-and-functioning/sava-commission/239

the Sava River Basin' [26], the 'Policy on the Exchange and Use of Sava GIS Data and Information' [27] , and the 'Memorandum of Understanding on Cooperation Concerning Regular Functioning and Maintenance of the Flood Forecasting and Warning System in the Sava River Basin' [28], describe the mandate for the cooperation in sharing of data.

Monitoring data of the environmental conditions of transboundary waters are shared as well as information on measures taken and planned, national regulations and critical situations, such as emerging floods or droughts and accidental pollution. Data is shared on a daily and hourly basis to both joint and national databases. Decisionmakers are informed through operational information systems and reports, e.g., yearly hydrometeorological yearbooks.

In accordance with its Financial Rules, general financing of the ISRBC activities is organized as follows: General Fund for the purpose of accounting for the expenditures of the ISRBC made within realization of its regular activities; Reserve Fund to provide funds to maintain the budget balance; Special and Trust Funds established for the purpose of receiving funds and making payments for purposes not covered by the regular budget of the Sava Commission.

The income of the General Fund is derived from mandatory annual contributions by the Parties on an equal basis and miscellaneous income. It accounts for expenditures related to the Secretariat staff salaries and allowances, current costs, travel expenses, operational costs, equipment, etc., while the Reserve Fund accounts for maintaining the budget balance.

The inflows into the Special and Trust Funds come from grant funds of different organizations for the implementation of special projects. Among other activities, the financing of data-sharing is supported through the Special and Trust Fund and it is related to the project-based funding. The monitoring and sharing of data, modelling, and forecasting activities have been financed mainly through grants from the European Commission and the Western Balkans Investment Framework (WBIF), but also the U.S. Government and other organizations.

As the operational integrated information system (Sava GIS, Sava HIS, Sava Flood Forecasting and Warning System (Sava FFWS)) demand continuous and regular maintenance and support, financing these activities also benefits the Special Fund.

Long-term plans to improve the sharing of data, modelling and forecasting as well as new software and hardware is related to the financing by the World Bank, Global Environment Facility (GEF), Special Climate Change Fund under Sava and Drina Rivers Corridors Integrated Development Programme.

Source: Case study provided by Mirza Sarač, International Sava River Basin Commission (ISRBC), 2023

Case study 11. Financing of the OKACOM Data Sharing Procedure

Lessons learned covered in this case study: Lesson 6, Lesson 26

The Okavango River basin is shared between Angola, Botswana and Namibia. Cooperation takes place in the Permanent Okavango River Basin Water Commission (OKACOM). [29] The countries have statistical agencies, which are the primary national institutions mandated with documenting, storing and distributing national data. With respect to water resources/basin data the institutions are the Office for the Administration of the Cunene, Cubango and Cuvelai Watersheds (Gabinete para Administracão das Bacias

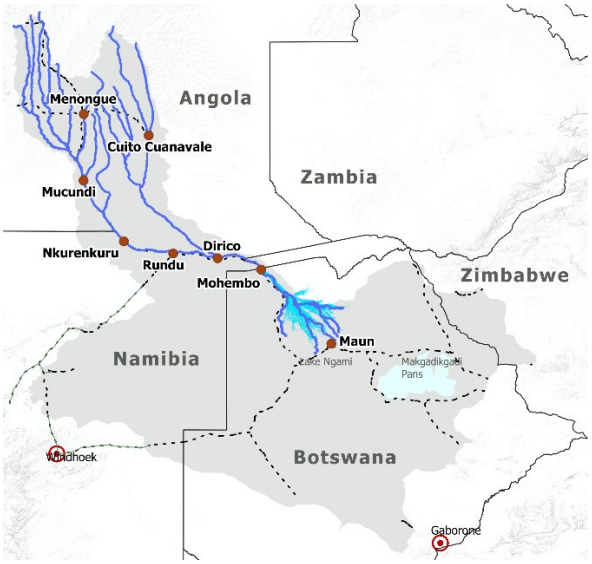
26 https://savacommission.org/UserDocsImages/05_documents_publications/basic_documents/dataexchangepolicy_en.pdf

27 https://www.savacommission.org/UserDocsImages/05_documents_publications/basic_documents/savagis_datapolicy_v1.0_and_annexes_final.pdf

28 https://www.savacommission.org/UserDocsImages/05_documents_publications/basic_documents/memo_of_understanding_on_savaffws.pdf

29 https://www.okacom.org

Hidrográficas do Cunene, Cubango e Cuvelai) in Angola, the Department of Water and Sanitation in Botswana, and the Department of Water Affairs in Namibia.



OKACOM developed Data Sharing Procedures as the jointly agreed instrument for data-sharing among Member States. Data-sharing has been going on since 2020 based on this agreement. The agreement also led to the establishment of the OKACOM Environmental Monitoring Framework which is typically a compendium of procedures and standards for monitoring and data collection.

Each Member State finances all data collections as per its usual departmental activities. International Cooperative Partners (ICP) from time to time also support joint data collection and basin-wide monitoring which contributes greatly to data on ungauged streams.

The data-sharing procedures set some quality assurance principles. The OKACOM Decision Support System (DSS) ensures that data will be stored in a consistent format from all Member States and at the same time provides a platform for harmonization of national databases both in data format, technology and systems used for hydrometeorological gauging and data storage. To assist fill gaps in data at strategic points in the basin, OKACOM with financial assistance from the European Union, installed eight hydromet stations shown in the Figure.

The data from Hydromet stations is inputted into the flood early warning system and used for basin assessment through modelling. Decision makers are informed through direct information sharing and at OKACOM statutory meetings which take place twice a year. The DSS has a basin assessment module which provides password-protected access to data and modelling results. Information is posted on the OKACOM Website, but the DSS also has a dashboard section providing information to the public through the web. Also, information is shared through community visit programs.

Source: Case study provided by Phera Ramoeli, Permanent Okavango River Basin Water Commission (OKACOM), 2022

Lesson 7. Use existing RBO and non-RBO institutions and mechanisms for transboundary cooperation to the extent possible.

Where there is a mechanism for cooperation, either formalized or informal, and either targeting a basin or cooperation on water resources in general, such a mechanism can be used to extend and improve the cooperation on data-sharing. A River Basin Organization (RBO) is an obvious mechanism, but other arrangements can also serve transboundary cooperation.

Case study 12. Developing cooperation on the Ocotepeque-Citalá Transboundary Aquifer (OCTA)

Lessons learned covered in this case study: Lesson 1, Lesson 4, Lesson 7, Lesson 9, Lesson 10, Lesson 17, Lesson 19, Lesson 31, Lesson 35, Lesson 40

The Ocotepeque-Citalá Transboundary Aquifer (OCTA) is shared between Honduras and El Salvador and located in the Lempa River Basin and the Trifinio Region, shared between Guatemala, Honduras and El Salvador. Between 2013 and 2022, the General Directorate of Water Resources of Honduras and the Ministry of Environment and Natural Resources in El Salvador collaborated on the OCTA in the framework of the project Governance of Groundwater Resources in Transboundary Aquifers (GGRETA), implemented by UNESCO-IHP in close partnership with IUCN, IGRAC and national counterparts and with support of the Swiss Agency for Development and Cooperation (SDC). The national government institutions were actively engaged, especially in capacity strengthening, awareness raising, and knowledge generation. They shared

data about the OCTA, including for a multidisciplinary assessment aimed at understanding the aquifers' hydrology, hydrogeology, stakeholder interests, pollution issues, and legal and institutional frameworks. [30] This data became part of the OCTA database, which will serve as a basis for future transboundary monitoring in the OCTA. The data is also part of the GGRETA Information Management System. [31]

The activities strengthened the dialogue on the OCTA among a variety of stakeholders in the region. There was a consensus that the challenges related to groundwater quantity and quality in the aquifer need to be addressed with a basin-wide and participative approach. While the OCTA is shared between the two states of El Salvador and Honduras, transboundary groundwater exchange may still happen between all three states through connected surface water (the Lempa River), [32] illustrating the critical need for conjunctive management of surface water and groundwater in transboundary settings.

In 2019, a Letter of Intent was signed by representatives of OCTA stakeholders: the governments of El Salvador and Honduras, the Trinational Commission of Plan Trifinio (CTPT), [33] municipalities located in the OCTA area of both countries, water boards and the association of municipalities (Mancomunidades) of the Trifinio Region. The letter represents their commitment to cooperate for the creation of a joint governance structure tasked with cooperation on sustainable management of shared water resources through e.g., data collection and compilation of information necessary for good management of the water resources of the OCTA, sharing of information with all stakeholders, and identification of possible sources of financing to fulfil its objectives.

Building upon the Letter of Intent, the stakeholders co-developed a policy instrument (a joint roadmap) in 2022 to support the materialization of the letter by identifying key actions to guide the binational management of the OCTA. It includes a strategic line focusing on the generation, dissemination, and use of hydrogeological knowledge for the participatory management of the aquifer. Activities within this line include setting up a monitoring network to fill important knowledge gaps towards an integrated management of groundwater and surface water. The roadmap proposes to integrate, in the future, its strategic lines and activities in a program or project within the CTPC. As a trinational cooperation mechanism between El Salvador, Guatemala and Honduras, OCTA stakeholders agreed that the CTPT could provide a stable legal and institutional structure for implementation of coordinated actions across the three countries, as well as a platform to seek financial support as needed.

Source**:** Case study provided by Karen Villholth, Water Cycle Innovation based on reports by UNESCO-IHP, 2023

Case study 13. Extending the mandate of the Organization for the Development of the Gambia River

Lessons learned covered in this case study: Lesson 4, Lesson 7

The Organization for the Development of the Gambia River (OMVG) is a regional organization comprising four member countries, Gambia, Guinea, Guinea-Bissau and Senegal. It was created on June 30, 1978, by Gambia and Senegal for the development of the resources of the Gambia River. In 1981 and 1983 the Republics of Guinea and Guinea-Bissau joined the organization. Following these memberships, in 1987, the competences of the OMVG were extended to the watersheds of the Kayanga/Géba and Koliba/Corubal rivers. The existing RBO was thus used to extend the cooperation.

The High Commission of the OMVG is the executing organ of the integrated development programs of the four member countries for a rational and harmonious exploitation of the common resources of the basins of the Gambia, Kayanga-Géba and Koliba-Corubal rivers. To this end, the High Commission is responsible

[30] https://unesdoc.unesco.org/ark:/48223/pf0000245263

[31] https://www.un-igrac.org/resource/ggreta-information-management-system-ims

[32] http://groundwatercop.iwlearn.net/gefgwportfolio/ggreta/trifinio

[33] The CTPT is a regional organization that is part of the Central American Integration System (SICA). In 1997, a treaty was signed between the Republics of El Salvador, Guatemala, and Honduras for the execution of the Trifinio Plan, as a model of integration and conservation, aimed at managing the territory to improve the living conditions of local communities.

for collecting basic data concerning the three rivers under its jurisdiction on the territories of the Member States. The Technical Ministries in charge of the monitoring and management of water resources and the supervisory Ministries in the various Member States, through the OMVG national units, have a memorandum of understanding for the monitoring and sharing of water data in the watersheds under the jurisdiction of the OMVG.

The tripartite agreement signed between the High Commission and the member states for the sharing of water data defines the obligations of each of the signatories:

- Technical ministries in charge of monitoring and managing water resources: diagnosis and rehabilitation of the network of hydrometric stations, data collection, updating of data and analysis thereof;
- OMVG National Unit of the supervisory Ministry: coordinate activities and play the role of interface between the OMVG and the National Technical Services responsible for monitoring measurement networks, collection, processing and updating databases in the watersheds under the jurisdiction of the OMVG;
- High Commission of the OMVG: ensure the administrative coordination of the activities and provide the technical Ministries through the National OMVG Units of the supervising Ministries with the financial means for the realization of the activities.

Source: Case study provided by Paul Haener, Office International de L'Eau (OiEau), 2022

Case study 14. A mechanism for cooperation in the KAZA Transfrontier Conservation Area

Lessons learned covered in this case study: Lesson 5, Lesson 7, Lesson 17, Lesson 19, Lesson 20, Lesson 39, Lesson 40

The Kavango Zambezi Transfrontier Conservation Area (KAZA TFCA) is shared between Angola, Botswana, Namibia, Zambia, and Zimbabwe and is the world's largest transboundary conservation area (520,000 km^2). Cooperation between the five states is formalized through the KAZA TFCA Treaty, signed in 2011. This agreement lays the foundation for joint and international cooperation around the protection and management of significant ecosystems and ecoregions that cut across two or more of the five member states. The KAZA TFCA is not, *per se*, defined by hydrological boundaries, but rather by the conglomeration of an array of interconnected protected areas that are under current threat from population growth, land use change, economic development, and climate change. The aim of the cooperation is to enhance the protection and management of significant ecosystems and ecozones through joint legal frameworks and planned measures, e.g., by establishing corridors and buffer zones to facilitate natural migration routes of wildlife and to protect biodiversity. The KAZA TFCA includes the iconic Okavango Delta, Victoria Falls, and many other often wetland-connected systems that cut across two or more of the five states. Hence, cooperation on water resources is essential in TFCA sustainability.

Many of the surface water and wetland systems are sustained by transboundary aquifers, of which there are five mapped in the KAZA TFCA, and management of these aquifers, along with the surface water systems, is increasingly acknowledged through cooperation on groundwater across the KAZA TFCA. [34] Limited data collection, and hence knowledge on transboundary aquifers linked to TFCAs in Africa is prevalent, because priority for monitoring is given to surface water and because of under-recognition of the role of aquifers in supporting wetlands, and more broadly terrestrial and aquatic ecosystems - so-called groundwater-dependent ecosystems.

For the KAZA TFCA, incipient groundwater data collection and sharing have been associated with the transboundary Kwando River Basin - a key tributary to the Okavango Delta - and a number of transboundary aquifers, e.g., the Nata Karoo Sub-basin [35] and the Eastern Kalahari Karoo Basin Aquifer. [36] This knowledge base provides a critical baseline for the understanding of these integrated systems,

[34] https://kaza-grow.iwmi.org/

[35] https://link.springer.com/article/10.1007/s10040-018-1896-x

[36] https://sadc-gmi.org/publications/#Eastern-Kalahari-Karoo-Basin-Aquifer-System

including delineation of the underground geological formations and aquifers and their connection and contribution to surface water systems. This work forms an important foundation for the identification of knowledge gaps, critical issues associated with water resources and contributes to better design of joint monitoring networks and programs, data-sharing, and information systems.

The KAZA TFCA partly overlaps with two major river basins: the Cubango-Okavango River Basin and the Zambezi River Basin. The need for integrated management of water resources and linked ecosystems is becoming increasingly apparent and acknowledged in TFCA and river basin organizations. [37] Hence, significant progress and synergy on cooperation related to shared water resources and ecosystems in the KAZA TFCA hinges on the close cooperation between OKACOM and ZAMCOM, separately, as well as in the framework of the KAZA TFCA Treaty. To facilitate this, an MoU has been signed between OKACOM and the KAZA TFCA Secretariat, and one is pending between ZAMCOM and the KAZA TFCA.

Source: Case study provided by Karen Villholth, Water Cycle Innovation based on Water Cycle Innovation [38] project reports, 2023

Lesson 8. Create a specific working group responsible for monitoring as part of a joint commission's institutional framework.

A specific working group or similar organizational unit on monitoring with the necessary technical capabilities can make the necessary specific technical arrangements, thereby reducing the need for extensive political discussions. Agreement needs to be reached about the data to collect, and this is an iterative process that needs to be done regularly. By establishing a working group to decide about which data to collect and where, the work can be done in a targeted way. The proposed data collection can subsequently be agreed upon by the decisionmakers. Also, agreement needs to be reached about the comparability of the data and information. Harmonization can be done by using the same methods and data formats, but it can also be done by ensuring that the data produced through different methods are comparable (see Lesson 26). The working group nevertheless needs an appropriate mandate to fulfil its tasks.

Case study 15. Regional Working Group for the Senegalo-Mauritanian Aquifer Basin (SMAB)

Lessons learned covered in this case study: Lesson 2, Lesson 7, Lesson 8, Lesson 19, Lesson 40

The Senegalo-Mauritanian Aquifer Basin (SMAB) is shared between Gambia, Guinea Bissau, Mauritania and Senegal. As part of its accession process to the Water Convention, Senegal requested support for the development of a cooperation initiative on the aquifer and for deepening the knowledge on the aquifer. The Regional Working Group for Transboundary Cooperation on the SMAB was established with the support from the Water Convention Secretariat in April 2020, bringing together four governments, the Organization for the Development of the Gambia River (OMVG) and the Organization for the Development of the Senegal River (OMVS). [39]

The Department of Water Resources (DWR) in Gambia, the General Directorate of Water Resources (Direção Geral de Recursos Hídricos, DGRH) of Guinea-Bissau, the National Centre of Water Resources (Centre National des Ressources en Eau, CNRE) in Mauritania and the Directorate of Water Resources Management and Planning (Direction de Gestion et de Planification des Ressources en Eau, DGPRE) of Senegal are responsible for the data and information sharing. Focal persons from these four institutions form part of the Regional Working Group, a body mandated to sharing data and advancing the cooperation between the four countries in terms of groundwater management in the SMAB.

Cooperation under the Regional Working Group allowed strengthening the understanding of the aquifer characteristics and development of a joint vision. In September 2021, the ministers in charge of water in the four countries signed a declaration in which they committed to establishing a legal and institutional

[37] https://unesdoc.unesco.org/ark:/48223/pf0000383775

[38] https://watercycleinnovation.com/

[39] https://unece.org/media/press/360381

framework for cooperation for the sustainable management of the SMAB and charged the Regional Working Group to enable the sharing of data on the SMAB. The two transboundary basin organizations (OMVS and OMVG) will provide the Secretariat for the Regional Working Group, which will elaborate the future intergovernmental mechanism for concerted management of the SMAB. External funding is sought to finance the activities planned by the Regional Working Group, including the sharing of data.

Source: Case study provided by Arnaud Sterckx, International Groundwater Resources Assessment Centre (IGRAC), 2022

Case study 16. Working Group 'Hydrology' of the International Meuse Commission

Lessons learned covered in this case study: Lesson 4, Lesson 8, Lesson 24, Lesson 35

The Meuse River basin is shared between France, Luxembourg, Belgium, Germany, and the Netherlands. The International Meuse Agreement was signed in 2002. The Agreement states that the Contracting parties shall cooperate "in coordinating the implementation of the requirements of the Water Framework Directive (WFD) to achieve the environmental objectives it sets out and, in particular, in coordinating all programs of measures for the International River Basin District Meuse", "in part by means of preventive measures – to reduce the impact of floods and droughts", and "in consulting each other and then coordinating preventive and protective measures against floods, giving consideration to ecological aspects, regional planning, landscape conservation and other fields such as agriculture, forestry and urban development". "The implementation of the requirements of the Water Framework Directive shall be coordinated multilaterally within the International Meuse Commission (IMC), through its working group 'WFD'". In particular, this shall involve the coordination of:

a) the analysis of the characteristics of the International River Basin District Meuse;

b) the investigation of the impact of human activities on the status of surface waters and groundwater in the International River Basin District Meuse;

c) the economic analysis of water use;

d) monitoring programs; and

e) the sharing of information between operational centers.

Concerning the flooding component, an agreement on data-sharing and flood forecasting within the Meuse International River Basin District was signed on 9th December 2016 entailing the mutual and continuous sharing of hydrological data and forecasts (water levels, flows) between the services (see Case study 42). There is no charge for the sharing and no additional costs for the services. The IMC Working Group 'Hydrology' is responsible for monitoring and updating this agreement.

Concerning the low-water component, the way to calculate the average discharge for seven days was discussed and validated in the Working Group 'Hydrology' of the IMC. The delegations also agreed on the most relevant stations to be included in the low water notice and, on the text, tables and map within the document. The secretariat oversees the collection of data every Monday, updating the low water notice and publishing it on the IMC website. Each delegation is using its own data to evaluate the low water level in its part of the basin so that public authorities and decision makers can take appropriate measures concerning water uses. However, the IMC's low water notice gives an overview of the situation in the whole basin so that downstream countries can prepare themselves regarding the situation upstream.

Finally, concerning the water quality component, delegations have agreed to follow 55 parameters at the same frequency, with the same analytical method and the same standards, within the Homogeneous Measurement Network (39 stations). The monitoring and evaluation of the homogeneous measurement network is carried out by the IMC Working Group 'Monitoring'. [40]

Source: Case study provided by Jean-Noël Pansera, International Meuse Commission (IMC), 2023

[40] http://www.meuse-maas.be/Accueil/La-commission-internationale-de-la-Meuse.aspx?lang=en-US

Case study 17. Data harmonization for the International Commission for the Protection of the Rhine (ICPR)

Lessons learned covered in this case study: Lesson 8, Lesson 39

For the benefit of the Rhine and of all waters running into the Rhine, the members of the International Commission for the Protection of the Rhine (ICPR) – Switzerland, France, Germany, Luxemburg, the Netherlands and the European Commission successfully co-operate with Austria, Liechtenstein and the Belgian region of Wallonia as well as Italy. The ICPR was founded in 1950 to analyze the pollution of the Rhine, to recommend water protection measures, to harmonize monitoring and analysis methods and to exchange monitoring data.

Today, an international expert group dealing with the regular chemical monitoring meets twice a year. First, the requirements for the monitoring were discussed and defined in the group. Nowadays, the parameter list provides mandatory and optional parameters for all monitoring sites along the Rhine and is updated every six years. In addition, the Rhine substance list is updated every three years. It contains substances that are currently relevant for the Rhine.

The data is collected yearly and published online. The expert group is writing reports on the water quality of the Rhine based on this data every two years (from now on every three years). These reports are published online.

Additionally, since 2015 there is an expert group dealing with non-target and target analyses of polar, persistent, mobile and toxic substances that cannot be detected by the analytical methods which are used routinely. The goal is to make analytical results comparable for substances for which no standardized methods exist.

Source: Case study provided by Tabea Stötter, International Commission for the Protection of the Rhine (ICPR), 2023

Lesson 9. Engage key parties, including civil society, NGOs, and the private sector.

Various parties have an interest in water resources and need information about the resources, including civil society, NGOs and private parties like farmers or hydropower operators. Such parties collect information and are interested in additional information. Joining forces in collecting data and information can be of mutual benefit.

Case study 18. Towards binational monitoring of the Transboundary Aquifer System in Leticia-Tabatinga (Colombia and Brazil)

Lessons learned covered in this case study: Lesson 9, Lesson 18, Lesson 19, Lesson 35

The twin Amazon cities of Leticia in Colombia and Tabatinga in Brazil are connected via the Avenue of Friendship. In addition to the permanent cultural, economic, and social exchange, both cities benefit from the groundwater of a shared transboundary aquifer system.

In 2015, the Amazon Cooperation Treaty Organization (ACTO) made the first assessment of the transboundary aquifer in Leticia-Tabatinga to collect information and promote the sustainable management of these resources in the region.

Currently, the two countries are carrying out a *Hydrogeological, vulnerability and risk assessment for the development of groundwater use and protection policies in the transboundary region of Leticia (Colombia) and Tabatinga (Brazil)*, in the framework of the Amazon SAP Implementation Project (ACTO/UNEP/GEF). The study area comprises the urban area and part of the suburban area of Leticia and the urban area of Tabatinga, located on the left bank of the Amazon River, on the border between Colombia, Brazil and Peru.

The binational initiative seeks to update the baseline of groundwater demand, assess the aquifer's vulnerability and potential sources of contamination, and design a groundwater quality and level monitoring network, oriented to define policies and technical guidelines for the use and protection of groundwater sources and a strategy for mitigating the contamination risks in the region.

More than 90% of the study has been completed, under the supervision of a Binational Technical Group (integrated by senior professionals from the National Water Agency of Brazil and the Ministry of Environment and Sustainable Development of Colombia). The progress and main results of the initiative were shared and discussed with the relevant national, state/department, and municipal stakeholders, academia, users and social actors at two Binational Workshops (Leticia, September 2022 / Tabatinga, June 2023).

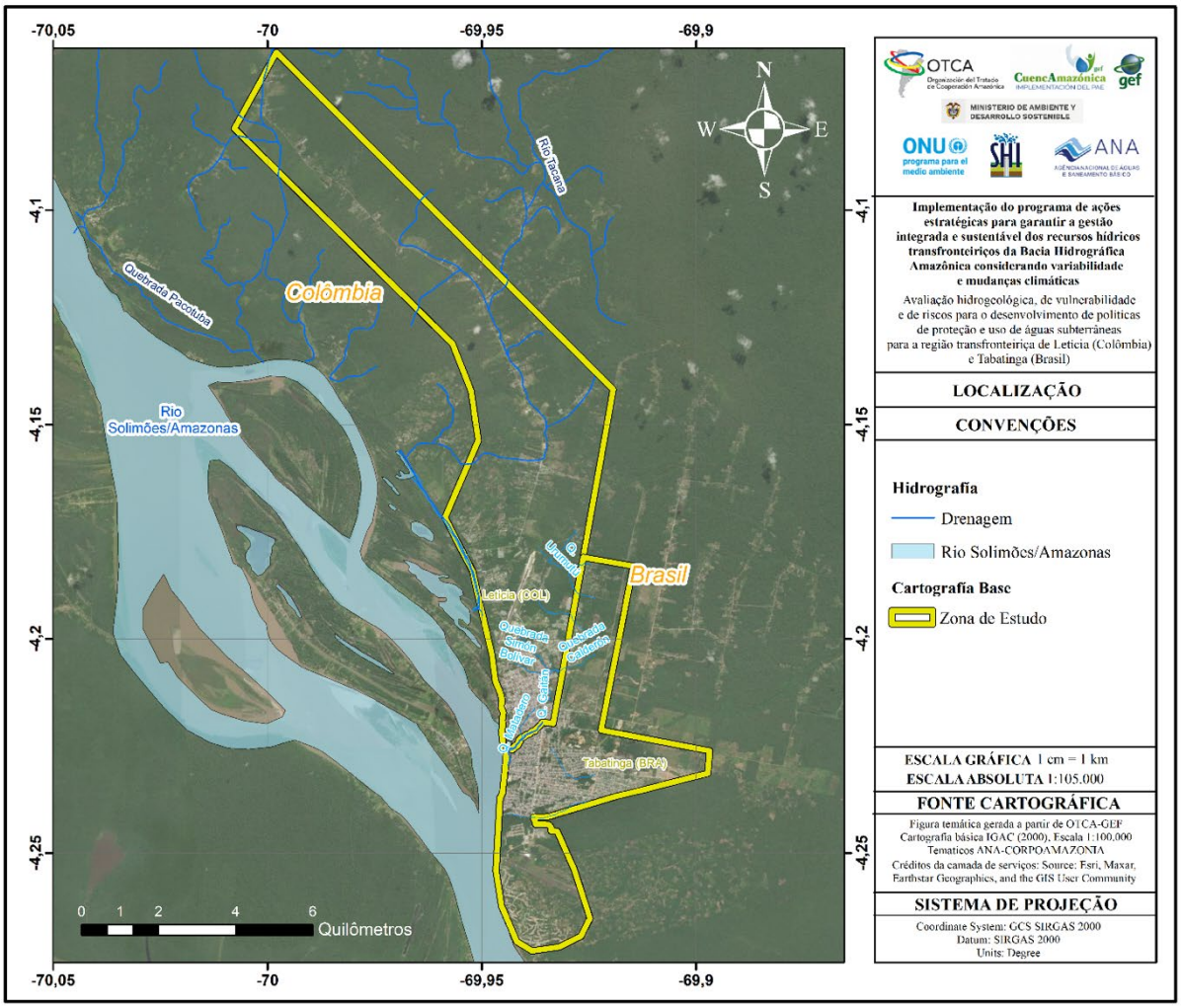
The main results include:

- Update of the inventory of groundwater points (121 points in Tabatinga and 226 in Leticia), which included 68 additional points (39 in Leticia and 29 in Tabatinga), showing that groundwater is mainly used for domestic purposes and to a lesser extent for public supply (consumption), industrial, recreational and livestock uses;
- Sanitary diagnosis of the catchments, finding out that close to 70% of points inventoried comply with the sanitary infrastructure conditions related to point source pollution protection.
- Design of a groundwater monitoring network, which includes 60 points: 35 in Leticia and 25 in Tabatinga. The results of the first laboratory analyses in this network identified a difference between the groundwater of both municipalities, with higher values of electrical conductivity, dissolved solids, nitrates, chlorides and a higher degree of mineralization in the wells of Tabatinga compared to those of Leticia. Also, the results indicate that the groundwater is characterized by a constant interaction with rain and surface water.
- Assessment of the intrinsic vulnerability to aquifer contamination evaluated by two different methods GOD and DRASTIC showing in both cases, a predominance of areas with moderate vulnerability (70% and 76% respectively) followed by high vulnerability (21% and 23% respectively) in this case associated with the presence of shallow aquifers, and in smaller proportion areas with low vulnerability to contamination (1% and 9% respectively).
- Inventory and analysis of activities with potential to become sources of groundwater contamination, such as deficient sewerage in urban areas, inadequate solid waste disposal, presence of effluent lagoons, inadequate storage or distribution of fuels, clay exploitation, presence of industries, cemeteries and slaughter plants.
- Intrinsic vulnerability maps and maps of potential sources of contamination were also cross-referenced, showing that approximately 45% of the study area corresponds to areas of high and very high risk, located mainly south of Leticia and in the urban area of Tabatinga.

At the II Binational Workshop (2023), to ensure sustainability of the binational groundwater monitoring network, the local governments committed to include the implementation of the automatic groundwater monitoring network in the agenda of the "Brazil-Colombia Binational Integration and Neighborhood Commission," and to dedicate technical teams and equipment to monitor both surface and groundwater.

The next steps include the definition and agreement of policies and technical guidelines for the use, monitoring and protection of groundwater sources and a strategy for mitigating the contamination risks in the region.

Photos: Collection and analysis of water samples and wastewater discharges, Leticia, Source: ACTO / SHI SAS-15-09-2022



Map: Location of the area of study, source: ACTO/ SHI SAS, 2023.

Source: Case study provided by Maria Apostolova, Amazon Cooperation Treaty Organization (ACTO), 2023

Lesson 10. Ensure an integrated and cross-sectoral approach for the monitoring system.

Supporting integrated water resources management also asks for an integrated approach in collecting data and information. This includes sectoral considerations like water use but should also encompass environmental considerations to avoid deterioration of environmental conditions that will ultimately have a negative effect on socio-economic conditions. For informed decision-making, data and information is needed on, among others, sources of problems and effectiveness of measures. It is recommended to collect and share data and information along the lines of the Driving force – Pressure – State – Impact – Response (DPSIR) framework. For instance, information from different sectors is needed, like information about abstractions for irrigation or industrial production, or about use of pesticides and fertilizers. The information relates to surface- and groundwater and possible interactions between them. This information can be combined with information from the monitoring system to identify sources of problems or potential problems in case of, e.g., water scarcity.

Case study 19. Environmental priorities in recent transboundary water agreements between Ecuador and Peru

Lessons learned covered in this case study: Lesson 4, Lesson 10, Lesson 24, Lesson 39

Recent transboundary water agreements are progressively adopting provisions on sustainable development, ecosystem-based approach and climate change adaptation.

Ecuador and Peru share nine transboundary river basins, two flowing into the Pacific Ocean (Zarumilla and Puyango - Tumbes) and seven flowing into the Amazon River (Catamayo-Chira; Mayo-Chinchipe; Santiago; Morona; Pastaza; Conambo-Tigre and Napo). In 2017, the Governments of Peru and Ecuador adopted the "Agreement that Establishes the Binational Commission for the Integrated Water Resources Management of the Transboundary Basins between Peru and Ecuador". This Agreement constitutes one of the latest transboundary water agreements in South America and the first one in the region to provide a framework to regulate all transboundary river basins shared between two countries.

The Agreement also consolidates bilateral cooperation to enhance the use and management of shared waters focusing on aspects such as sustainable development, ecosystem-based approach and climate change. This instrument also provides that one of the main functions of the Binational Commission is to propose climate change adaptation and mitigation measures based on data and information exchange that will guide early warning systems and overall response to extreme climate events.

Ecuador and Peru are currently drafting the Rules of Procedure of the Binational Commission that will guide the specific functions and activities at the transboundary level, as well as at the local level in each one of the nine river basins. Considering the unique characteristics and challenges of each one of these transboundary river basins, it is likely that Ecuador and Peru draft various basin instruments in specific areas such as data and information exchange, which can guide other States negotiating framework and basin level agreements.

Source: Case study provided by Diego Jara, International Union for Conservation of Nature (IUCN), 2023

Case study 20. Zambezi Watercourse Information System

Lessons learned covered in this case study: Lesson 10, Lesson 11, Lesson 12, Lesson 39

The Zambezi River Basin is shared between the Republic of Angola, the Republic of Botswana, the Republic of Malawi, the Republic of Mozambique, the Republic of Namibia, the United Republic of Tanzania, the Republic of Zambia and the Republic of Zimbabwe. Under the Zambezi Watercourse Commission (ZAMCOM), a common repository, the Zambezi Water Information System (ZAMWIS) has been established. The Zambezi Watercourse Secretariat (ZAMSEC) is the responsible institution.

ZAMWIS was established through the Rules and Procedures for Sharing Data and Information Related to the Management and Development of the Zambezi Watercourse that was adopted on 25th February 2016 by the Council of Ministers. Contributions from Members States and development partners finance the system.

Information on Hydrology, Meteorology, Water quality, Socio-economy, Environment and Planning instruments (e.g., policies, legal instruments, strategies, master plans, etc.) is shared through the system. Knowledge Products are also included in ZAMWIS. This is already existing information about the Zambezi Basin and includes but is not limited to:

- Water, Environment, Legal Statutes.
- Policies and Master Plans.
- Studies and Publications from Non-Governmental Organizations, Civil Society Organizations, RSP.

Data-sharing is done between ZAMSEC and the focal institutions. The data is shared online as an exchange file then uploaded to the ZAMWIS Database by the ZAMCOM Secretariat (ZAMSEC). Data is exchanged according to the schedule established in the Rules & Procedures protocol. The riparian states still own the information.

The database is open for the public to view the data. The following reports are produced for the ZAMCOM Technical Committee Members (ZAMTEC):

- Spreadsheets and Time series update when information is added to the database.
- Progress and Review Reports.
- Work Plan and Budget.

The shared database has led to:

- Confidence in the Notification process because the information is readily available.

- Regional mobilizing of funds. Among others, the Climate Investment Funds (CIF) will finance nature-based solutions to the climate crisis in the Zambezi River Basin Region, cutting across Zambia, Malawi, Mozambique, Namibia, and Tanzania.
- Capacity enhancement of the National Focal persons.
- Vision asymmetries of the member states are aligned through The Zambezi Strategic Plan (ZSP).
- Regional Economic Development – The Programme for Integrated Development and Adaptation to Climate Change in the Zambezi Watercourse (PIDACC) is an investment programme that contributes to the implementation of the Zambezi Strategic Plan for the Watercourse (ZSP 2018-2040).
- National Security Concerns – the ZAMWIS Decision Support System (DSS) helps to inform decision-making in planning processes in the Zambezi Basin for the benefit of cooperative human and economic development.

Source: Case study provided by Felix Ngamlagosi, Zambezi Watercourse Commission (ZAMCOM), 2022

Case study 21. Sharing of data in the Buzi, Pungwe and Save Basins

Lessons learned covered in this case study: Lesson 4, Lesson 10, Lesson 18, Lesson 31, Lesson 33

The Buzi, Pungwe, and Save Transboundary River Basins are shared by Mozambique and Zimbabwe. The Mozambique Zimbabwe Joint Water Commission has the mandate for data-sharing, laid down in the 'Rules and Procedures between the Republic of Zimbabwe and the Republic of Mozambique on the Sharing of Data and Information Related to the Development and Management of the Buzi, Pungwe and Save Watercourses'. The data-sharing includes: 1) hydrology; 2) hydrogeology; 3) climatology; 4) meteorology; 5) water quality; 6) socio-economy; 7) environment; and 8) planning Instruments.

In the Data Sharing Protocol (see Case study 7), the two countries have agreed to share information on the best available technology. Sharing the results of relevant research and development is also included in the protocol. Emission data of pollutants and wastewater is confined to water quality as well as pollution threats.

Potential planned measures have been identified and are included in the signed water sharing agreements. In the agreements member states are also required to notify each other on new planned measures that are to be undertaken. The member states are supposed to notify the other party well in advance.

National regulations are included in the information to be shared.

Critical situations (e.g., emerging floods or droughts, accidental spills) are included in the Data Sharing Protocol. There is an emphasis on emergencies e.g., pollution spillage, floods occurrences.

The Data Sharing Protocol promotes harmonization of data collection, processing and storage. A central repository of information Buzi Pungwe, Save Water Resources Information System (BUPUSAWIS) is planned.

Currently data are shared through weekly bulletins by email. BUPUSA WhatsApp group has been formed and information is shared daily, particularly during the rainy season. The sharing of information has now been regularized in the Data Sharing protocol. During the wet season data-sharing is daily for areas where there is high potential of flooding but less frequent during the dry season. Some key hydrological stations on the three transboundary rivers in both countries are being upgraded to transmit data in real time. The data-sharing ranges from 15 min interval to 1 hour.

Each country has its own database, but plans are to set up the BUPUSAWIS which will be available as a central data base. Both countries have agreed that there will be different levels of access to data.

Decision makers receive weekly reports.

The water authorities have websites where information is published. In the case of Mozambique, a weekly bulletin is published. In Zimbabwe dam levels are published on weekly basis. In both countries information is also share information through TV/radios.

Source: Case study provided by Loreen Katiyo, Global Water Partnership Southern Africa (GWPSA), 2022

Case study 22. Information sharing for the transboundary groundwater body Karavanke

Lessons learned covered in this case study: Lesson 4, Lesson 10, Lesson 23, Lesson 35

The Transboundary Groundwater Body Karavanke is shared between Slovenia and Austria. Data-sharing takes place within the bilateral working group „Reserves of Drinking Water Karavanke ", which is operating in the frame of the Permanent Slovenian-Austrian Commission for the Drava River, led by the Ministry of the Environment and Spatial Planning of the Republic of Slovenia and the Federal Ministry of Agriculture, Forestry, Regions and Water Management of the Republic of Austria.

The Permanent Slovenian-Austrian Commission for the Drava River is based on the Law on the Ratification of the Agreement between the Republic of Slovenia and the Republic of Austria on further validity of the appointed Yugoslav-Austrian Contracts in the relations between the Republic of Slovenia and the Republic of Austria, and the Agreement between the Government of the Republic of Slovenia and the Federal Government of the Republic of Austria on further validity of the appointed Yugoslav-Austrian Contracts in the relations between the Republic of Slovenia and the Republic of Austria (1993).

The data and information sharing is not exclusively financed. Contribution of experts to the working group is in kind, as a part of the activities needed for functioning of the Permanent Slovenian-Austrian Commission for the Drava River.

The data and information are shared as needed according to the agenda of the working group "Reserves of Drinking Water in Karavanke". Below are some examples of data and information sharing between both parties:

a) Monitoring data of the environmental conditions of transboundary waters: Information on groundwater (quantity and quality) monitoring locations together with monitoring specifics (measured parameters, frequency etc.) and data. The groundwater status (quantitative and qualitative) of the common groundwater body is regularly updated.

b) Results of relevant research and development: National hydrogeological findings are regularly discussed such as: unexpected, measured groundwater data, results of recent tracing experiments, new findings in determination of drinking water resources, hydrogeological specifics gained via common nations (tunnel excavation across the national border), work progress on relevant international and national projects etc.

c) Measures taken and planned are discussed such as the new concept presentation for water supply in municipalities within common groundwater body

d) National regulations: The national legislations are discussed and translated with the aim to meet the common protection of groundwater resources which flow across the national border (water protection zones delineation).

e) Permits: Information on recent granted water rights is regularly updated.

The parties follow ISO standards for the data quality control prescribed on a national level. Data is shared mostly using online transfer and tools with fast and adequate provision of information service. The working group meets annually. Data is shared according to the issues addressed in the working group meeting agenda. As most of the groundwater monitoring data is publicly available online, the additional transfer of the data is only rarely needed in recent years. The sharing of the reports is usually performed after the meeting. Data is stored in national databases. Most of the databases are accessible and open for public use.

Joint monographs and expert reports were produced in long-term cooperation between the parties of the working group. The parties are engaged in common international projects with the scope to maintain the good groundwater status of the common groundwater body. Joint reports are published every few years.

The reports and the progress of the working group are regularly reported on the regular annual sessions of the Permanent Slovenian-Austrian Commission for the Drava River.

Official minutes of the sessions of the Permanent Slovenian-Austrian Commission for the Drava River are available to the public on http://www.evode.gov.si/index.php?id=92.

Source: Case study provided by Aleš Bizjak, Ministry of Environment of Slovenia, 2022

Lesson 11. Facilitate trust building and collaborative learning.

Sharing of data and information supports building of trust among riparian countries. Transparency and openness throughout the monitoring process enhances trust building (see, e.g., Lesson 3). Moreover, transparency and openness about data and information supports learning from each other. Joint monitoring (Lesson 29), meetings, workshops, and other activities where representatives of riparian countries meet can help to build a better mutual understanding and collaborative learning and thus lead to improved trust.

Case study 23. Building multiple transboundary relationships: the experience of Hungary

Lessons learned covered in this case study: Lesson 2, Lesson 4, Lesson 11, Lesson 18, Lesson 23, Lesson 36, Lesson 40, Lesson 41

Hungary has transboundary water management commissions with all seven neighboring countries (Austria, Slovak Republic, Ukraine, Romania, Serbia, Croatia and Slovenia) with identical objectives but different structures. Bilateral Water Management Committees regulate the data exchange. The minutes from the annual meetings in general define the next year's work schedule and are forwarded to the Hungarian Ministry of the Interior and Ministry of Foreign Affairs and Trade. Watercourses and facilities of common interest are often visited by the two riparian countries together. The technical terms of the technical documentation are agreed upon. For the different commissions, the types of data that are shared as well as the form and frequency of data-sharing vary.

Throughout the years an outstanding professional and human exchange has developed between the hydrological specialists which allows them to communicate with each other outside of the official data reconciliation, thus facilitating joint work.

As an example, the Mureș River Basin shared between Romania and Hungary is described here.

In terms of water quality protection, the Hungarian-Romanian Water Quality Protection Subcommittee operates under the chairmanship of Lower Tisza District Water Directorate (ATIVIZIG) in the Mureș River Basin. This body, in accordance with its respective rules of operation, carries out the chemical, biological, and radiological analysis, monitoring, assessment, as well as collection and exchange of data on water quality. Furthermore, the Subcommittee monitors and, in the course of its work, evaluates water quality analysis results and interventions detected during specific pollution incidents with transboundary impacts.

Sampling and measurement tasks are carried out by the laboratories of the competent county government offices, with which there is daily contact.

The framework of international cooperation was laid down in bilateral water agreements. The designated organizations carry out their tasks in a hierarchical system as defined in the agreement. The Committee and Subcommittees carry out their tasks based on their rules of operation in force.

The financial resources for the operation of transboundary tasks are included in the budget of each institution. The respective costs of data and information sharing as defined in the rules are financed by the Parties themselves.

Data is shared about the relevant environmental status monitoring data for transboundary waters, about national regulations like in the event of changes in the national legal environment and meteorological standards, and on critical situations. In case of calamities immediate informal and formal written notifications take place.

Each year, the nationally accredited laboratories participating in the work of the transboundary water quality subcommittees take part in international comparative measurements, so-called intercomparison measurements, that guarantee the reliability of the test results. In addition, joint and regular water discharge measurements are carried out according to an annual schedule, and the results are evaluated with partner institutions in both countries. The Parties mutually inform each other on national measurement and data processing standards, in compliance with WMO recommendations.

Daily meteorological and hydrological data communication takes place in the form of data files attached to emails and hosted on FTP servers. The verified and processed hydrological time series are sent to each other by the Parties on paper and electronically before the meeting of the experts of the subcommittees

(once a year). The good relationship between the Parties guarantees the successful organization of the meetings. At the meetings, experts discuss and evaluate the results which are the subject of a joint report prepared in two languages and are shared between the Parties. The annexes of the minutes contain the results of the measurements, as well as their evaluation based on the appropriate methodology laid down in the rules. The reports are submitted to both the managing body (General Directorate of Water Management), and the Ministry of the Interior. Documents prepared on the activities of the Water Committee are not made public.

Another example of building multiple transboundary relationships is the ICPDR Danube Hydrologic Information System (HIS). The Danube HIS was created based on previous experiences with the Sava HIS. A long term sustainability of the system outputs could give Danube countries the possibility for future transnational flood and ice forecasting activities and early warning developments, for flood risk management or for any water related scientific activities in the Danube River basin.

A common platform was created, led by Hungary, to provide water level and discharge, water temperature and precipitation data for the Danube and its major tributaries. All Danubian countries have the possibility to join the data service.

Source: Case study provided by Peter Kovacs, Ministry of Interior, Hungary, 2022

Case study 24. Monitoring cooperation between Tajikistan and Uzbekistan

Lessons learned covered in this case study: Lesson 2, Lesson 3, Lesson 11

The Northern Fergana Canal and the Big Fergana Canal receive water from the upper part of the Syr Darya River and deliver irrigation water, first to Uzbekistan and then to Tajikistan. The water flow has been measured by hydroposts located on both sides of the borders. But the measurements from the two sides have shown differences and the equipment is presently in need of rehabilitation.

The two countries have agreed that instead of two hydroposts on the same canal, there will be one joint automated hydropost per canal – one on the Big Fergana Canal (BFC) and one on the Northern Fergana Canal (NFC). Both stations are to be located on the territory of Tajikistan.

In the framework of Switzerland's National Water Resources Management Program in Tajikistan, and on the request of the Ministry of Energy and Water Resources of Tajikistan, technical feasibility studies for the equipment to be installed at the BFC and NFC have been made. Different technological options for measuring of water flow in the canals were reviewed and an appropriate solution selected.

The Swiss Development Cooperation (SDC) within the framework of its Blue Peace Program, mandated HELVETAS Swiss Intercooperation to support the procurement and installation of the selected equipment on the condition that there is an effective governance framework in place to manage the joint operation and maintenance of the equipment and the exchange and use of the data produced.

On 10 May 2023 a protocol outlining principles of the joint water monitoring has been signed between Tajikistan and Uzbekistan and during autumn 2023 the equipment will be procured and installed. In the process, capacity is built on the local and national level to prepare for the needed cooperation.

Photo: Big Fergana Canal in Patar, Konibodom region

Source: Case study provided by Bo Libert based on reports from SDC project "Support to the rehabilitation of two transboundary hydroposts on the Big Fergana Canal and the Northern Fergana Canal, Tajikistan", 2023

Lesson 12. Support awareness raising and capacity development.

Awareness of the importance of basin-wide data and information as well as how it can be used at all levels (local to international) is essential to sustain a meaningful monitoring system. It is therefore necessary to

identify the needs for capacity development at all levels. Developing and implementing a capacity-development plan may be useful.

Case study 25. Capacity development by the International Meuse Commission

Lessons learned covered in this case study: Lesson 12

In response to the catastrophic floods of July 2021 (see Case study 42) and to strengthen international coordination at the scale of the Meuse basin (shared between France, Belgium and The Netherlands), the International Meuse Commission organized exchange seminars between the flood forecasting services of the 7 States and Regions of the basin in September 2021 and September 2022. These seminars allowed an analysis of climatic and hydrological events and exchanges on the difficulties of forecasting these extreme events. The International Meuse Commission also organized a training course on the European Flood Awareness System (EFAS) for flood forecasting services [41] in April 2023, to improve coordination and transboundary cooperation within the International Meuse basin.

Source: Case study provided by Jean-Noël Pansera, International Meuse Commission (IMC), 2023

Lesson 13. Adopt a step-by-step and iterative approach to monitoring in the transboundary basin.

Developing and maintaining a monitoring system is an iterative process of evaluating and improving, as depicted through the 'monitoring and assessment cycle' in the *Updated Strategies for Monitoring and Assessment of Transboundary Rivers, Lakes and Groundwaters*. [42] There is therefore no need to implement a fully developed monitoring system at once. A step-by-step approach can help to develop a system slowly and improve a system over time. For instance, a project can be the start of more regular cooperation and sharing of data and information. All work done in the project can act as the basis for further cooperation. Also, pilot projects can be useful instruments for a step-by-step-approach.

Case study 26. Step-by-step development of the activities of the Kazakhstan-Uzbekistan Working Group on Environmental Protection and Water Quality in the Syr Darya River Basin

Lessons learned covered in this case study: Lesson 2, Lesson 4, Lesson 8, Lesson 13, Lesson 24, Lesson 27, Lesson 43

In 1997, the Governments of Kazakhstan and Uzbekistan signed an agreement on cooperation on environmental protection and sustainable environmental management of water. In 2017, the Governments signed the Strategy for Economic Cooperation for 2017-2019, which included the activities of "creating a joint commission for cooperation on environmental protection" and "ensuring joint water sampling, analysis, and sharing of water quality data and regulations". The Joint Working Group on Environmental Protection and Water Quality in the Syr Darya River Basin was established in 2018.

The Working Group has held meetings, visited relevant laboratories, studied regulatory and technical documentation, made decisions on monitoring and reviewed the activities of stakeholders. In 2019, the Working Group approved a list of indicators to be measured, sites for joint water sampling and the analysis and sharing of results. In 2020, Kazakhstan and Uzbekistan agreed to review and determine the timing of sampling, taking into account the time for water to travel between sampling points. In 2021, the parties agreed to promptly notify each other of the occurrence of emergency situations and to perform joint analysis of water samples as well as share experiences of the joint analysis and capacity building.

In 2022, Kazakhstan and Uzbekistan invited representatives from Kyrgyzstan and Tajikistan to participate in the Working Group meeting as observers, as these two countries also share the Syr Darya basin. Kazakhstan proposed the creation of a joint 4-party working group to deal with water quality in the Syr Darya basin. An interim report on the implementation of the project "Development of Joint Measures to

[41] https://www.efas.eu/en

[42] https://unece.org/sites/default/files/2023-01/ECE_MP.WAT_70_ENG.pdf

Prevent and Respond to Pollution of the Syr Darya River in Emergency Situations" was presented. The meeting also considered the draft Program of Measures for the conservation and restoration of the ecosystem of the transboundary Syr Darya River for 2023-2025, which included activities to identify and eliminate sources of pollution to the river.

Since the establishment of the Working Group, Kazakhstan and Uzbekistan have made progress in the implementation of measures aimed at improving the ecosystem of the Syr Darya Basin. However, some challenges remain, such as the differences in the national regulations and standards as well as differences in the physical facilities of monitoring services, since water quality monitoring involves different agencies within each country who use different sampling sites and monitoring frequencies. The Working Group is planning to implement a comprehensive environmental survey of the Syr Darya Basin with the involvement of international organizations. The inclusion of Kyrgyzstan and Tajikistan in the activities on water quality in the Syr Darya river basin would represent an important step forward.

Source: Case study based on a presentation by Dana Agybayeva, Ministry of Ecology and Natural Resources of the Republic of Kazakhstan, 2023

Case study 27. Extension of monitoring in the BIO-PLATEAUX project

Lessons learned covered in this case study: Lesson 3, Lesson 4, Lesson 13, Lesson 23, Lesson 26

On two transboundary watersheds, the Maroni (Suriname and French Guiana) and the Oyapock (French Guiana and Brazil), a cross-border Observatory on water and aquatic biodiversity is under development. As part of the BIO-PLATEAUX project, which facilitates this prefiguration, the focal points are the French Guiana Water Office, Anton de Kom University, and the Amapa Economic Development Agency. The International Office for Water (OiEau) coordinates joint activities and runs the project. [43]

The three countries do not have a centralized system with an organization responsible for production and sharing of data, but a wide variety of producers who are sharing their data on water and aquatic environments. To cite just a few key players: in French Guiana: Directorate General for Territories and the Sea (DGTM – government services in French Guiana), and the French Guiana Water Office (OEG). In Brazil: National Water Agency at federal level, IEPA at Amapa State level. In Suriname, the Ministries of Natural Resources, Public Works, Environment or Regional Development.

The focal points of the BIO-PLATEAUX project signed, in the presence of their respective national and territorial authorities, two declarations promoting data-sharing and designated responsibilities in leading the process; the Declaration at the end of the Conference of Cayenne in November 2019, promoting a long-term joint initiative to get to know each other better, to know the water resources and to raise awareness of the issues of the Maroni and Oyapock watersheds, and the Declaration of the partners at the end of the Phase 1 of the project (April 2022), announcing a prefiguration of the cross-border Observatory by 2025. The project is supported by the European Union (INTERREG Amazonia Cooperation Programme), the Territorial Collectivity of French Guiana (CTG), the National Center for Space Studies (CNES), the General Directorate of Territories and the Sea (DGTM), the Office of the 'Eau de Guyane (OEG), and the French Office for Biodiversity (OFB).

The shared data include environmental status monitoring data (quantity/quality of surface water and groundwater) of water in transboundary basins, volumes withdrawn, drinking water and sanitation indicators and metadata of existing data sets. The partners also share documents and studies in a dedicated documentary space.

[43] www.bio-plateaux.org

Implementation of benchmarks are done at the national level. Production of metadata on the various data sets made available with implementation of national metadata catalogues. In the absence of common repositories set up between countries, data harmonization is often done on the fly during automatic import-export procedures using ETL (Extract Transform Load) tools. Data quality control remains the responsibility of data producers, the latter being invited to specify the quality control procedures implemented in their metadata sheets describing the data sets made available. The integration of data into the cross-border platform of the observatory also allows additional quality control through the possibility of cross-analysis between the data made available by the countries.

When the partners have developed information systems, data-sharing is mainly done via API (Application Programming Interface), WMS (Web Mapping Services) in a logic of strengthening open data and the interoperability of information systems. Various applications set up at the national level also allow the downloading of data sets. The sharing of reference data and "historical" data is done gradually, subject by subject. The regular updating of the data and the sharing of the data is then done in an automated way via interoperability processes between the information systems of the national producers (and/or the national information IS on water) and the platform of the Observatory. These processes make it possible to consume/harvest the data according to the needs according to the agreements and with variable frequencies which can go from real time to daily/ten-day/monthly/annual frequencies.

The data is archived in the information systems of the data producers, and the establishment of a national (or regional, as the case may be) platform allows the integration and cross-valorization of the data. The data is primarily stored in the databases of the data producers, who remain responsible for their data, and then possibly in the national information systems. Depending on the needs and authorizations, they can then be integrated into the framework of the Cross-Border Observatory platform. The data and products generated have different levels of access (public, private, restricted by password) depending on the case. Except in specific cases where a producer asks to respect the confidentiality of the data, most of the visualization products produced at the cross-border level are available online, accessible, and downloadable by the public.

From the moment the data is integrated into the cross-border platform, it can be used to produce reports, maps, bulletins, and for online visualization products such as interactive maps, interactive dashboards. In addition, an interactive catalogue of metadata, available online, should allow data consumers to have all the descriptive elements, in particular concerning data traceability and data production and quality control procedures, to be able to check whether the available datasets are likely to meet their needs.

Source: Case study provided by Paul Haener, Office International de l'Eau (OiEau), 2022

Lesson 14. Engage experts in the institutional structures in charge of transboundary cooperation.

Relevant experts, like hydrogeologists in an aquifer or hydrologists in a river basin, should be engaged on a permanent basis in the joint bodies in charge of the transboundary cooperation. This is needed to ensure that the proper knowledge and information is used in water management decisions, both at the national and transboundary level. Moreover, many countries have no strategy or capacity to consistently collect water data. Experts are needed to improve the consistency of the monitoring system and for a proper assessment of the transboundary water system based on the data as collected. This is even more important for groundwater, given the higher complexity of the underground systems.

Case study 28. Management of the transboundary deep groundwater body in the Lower-Bavarian/Upper-Austrian Molasse-Basin

Lessons learned covered in this case study: Lesson 8, Lesson 14, Lesson 19, Lesson 27, Lesson 35, Lesson 39

The transboundary deep groundwater body in the Lower-Bavarian-/Upper-Austrian Molasse-Basin is shared between Germany and Austria. For the sustainable geothermal use of the transboundary deep groundwater body in the Lower-Bavarian-/Upper-Austrian Molasse-Basin a strategy for use and protection of the deep transboundary groundwater body was jointly developed between Germany (Bavaria) and Austria. Details of the strategy are outlined in "Principles of geothermal use of deep groundwater body in the Lower-Bavarian-/Upper-Austrian Molasse-Basin" [44]. A bilateral Expert Group "Thermal Water" was established within the legal framework of the Regensburg Treaty (1987) on Water Management Cooperation in the Danube River Basin, in which the key authorities from the German federal state (Land) of Bavaria and Austria are represented. The Expert Group developed the scientific knowledge base, a combined and balanced monitoring program with regular data-sharing and appropriated tools, notably a numerical groundwater model, to support the transboundary management of the groundwater body.

Data and information sharing is organized in regular expert group meetings. Each Party is responsible to cover its own costs. Data is shared regularly at least once per year in frame of expert groups meetings. If needed, data is shared between responsible institutions on demand (e.g., via email). The data collected is kept in national databases.

Source: Case study provided by Andreas Scheidleder, Environment Agency Austria and Christian Schilling, Austrian Federal Ministry for Agriculture, Forestry, Regions and Water Management, 2022.

Lesson 15. Build on local knowledge.

At the local level, generally much knowledge and information is available about the water management situation as well as about possible measures. Building on this knowledge can lead to both innovative and efficient measures and improved local support and ownership. This may increase the effectiveness of activities and measures.

Case study 29. Promotion of indigenous ancestral knowledge to facilitate transboundary water negotiations in Lake Titicaca

Lessons learned covered in this case study: Lesson 4, Lesson 12, Lesson 15, Lesson 21, Lesson 26

The active participation of indigenous communities in transboundary water negotiations can be essential to improve the management and governance of shared waters.

The Lake Titicaca basin shared between Peru and Bolivia is home to nearly 3 million people in primarily rural communities. Indigenous peoples including the Quechuas, Aymaras and Uros have lived and flourished for centuries in this region, developing their traditional farming, fishing and trade systems. The ancestral knowledge accumulated over generations by these peoples is fundamental to ensure adequate protection of the Lake Titicaca basin.

In 1996, the Governments of Bolivia and Peru adopted an agreement to establish the *Lake Titicaca Authority (ALT)* whose main objective is to promote and conduct actions, programs and projects for the management, control and protection of the Lake Titicaca and the greater *Sistema Titicaca-Desaguadero-Poopó y Salar de Coipasa (TDPS).* The Statute creating the ALT stipulates that one of the main functions of this Authority is to secure the maintenance, continuity and use of information systems and mathematic models for the joint management of the TDPS.

After nearly thirty years of the creation of the ALT, environmental challenges for the Lake Titicaca have increased and become more complex. Pollution from mining activities, untreated wastewater and

[44] https://www.land-oberoesterreich.gv.at/files/publikationen/gtw_grundsatzpapier2012.pdf

agricultural runoff, as well as the effects of climate change require more holistic approaches to incorporate best practices to manage the Lake Titicaca. Here, indigenous ancestral knowledge combined with the use of new technologies is fundamental to ensure active participation in solutions to address the multiple challenges affecting the Lake.

Since 2016, indigenous women in the Lake Titicaca with the support of local and international organizations including Agua Sustentable and IUCN formed the group *"Mujeres Unidas en Defensa del Agua"*, Women United in Defence of Water. This is a dialogue platform to share lessons, experiences and best practices to protect their sacred Lake Titicaca. These indigenous women have used drones and measuring devices to monitor the quality of waters of the Lake and inform decision making. These practices contribute to the overall understating of the conditions of the Lake and foster the active and informed participation of non-State actors in transboundary water negotiations.

Source: Case study provided by Diego Jara, International Union for the Conservation of Nature (IUCN), 2023

Further reading

UNCCD, 2023. Drought Toolbox. Monitoring and early warning https://www.unccd.int/land-and-life/drought/toolbox/monitoring-and-early-warning

UNCW, 2005. An integrated framework for wetland inventory, assessment and monitoring (IF-WIAM). https://www.ramsar.org/document/an-integrated-framework-for-wetland-inventory-assessment-and-monitoring-if-wiam

UNECE, 2006. Good Practice for Monitoring and Assessment of Transboundary Rivers, Lakes and Groundwaters. https://unece.org/info/publications/pub/21680

UNECE, 2018. Principles for Effective Joint Bodies for Transboundary Water Cooperation. https://unece.org/info/publications/pub/21755

UNECE, 2018. Financing Climate Change Adaptation in Transboundary Basins. https://unece.org/info/publications/pub/21764

UNECE, 2021. Funding and financing of transboundary water cooperation and basin development. https://unece.org/info/publications/pub/359843

UNECE, 2021. Agreements for Transboundary Water Cooperation: A Practical Guide. https://unece.org/info/publications/pub/361821

UNECE, 2023. Updated Strategies for Monitoring and Assessment of Transboundary Rivers, Lakes and Groundwaters. https://unece.org/info/publications/pub/375468

WMO, 2021. Technical Regulations (WMO-No. 49), Volume III: Hydrology. https://library.wmo.int/index.php?lvl=notice_display&id=10700

WMO, 2021. Guide to Instruments and Methods of Observation (WMO-No. 8). https://library.wmo.int/index.php?lvl=notice_display&id=12407

3. Set-up of the data-sharing

Data-sharing entails determining what data and information is to be shared. This includes looking at what data and information is relevant for the respective institutions responsible for collecting and disseminating information at the basin level and other levels as well as the data and information that is relevant for the policy making process. Thereby, it is important that the countries involved agree on the data and information that is to be shared. To this end, issues and priorities related to the use and protection of a transboundary river, lake, groundwater, or transitional water – and their ecosystems need to be identified. This includes looking at the uses and functions of the basin, the pressures and pollution sources in the basin, the available (and accessible) information, the relevant criteria and targets (like water quality classes and e-flows), and the water and environmental legislation in the riparian countries. Subsequently the most practical way of

gathering data from various sources including the monitoring system, expert judgments, statistical publications, open data sources, remote sensing, citizen science, Indigenous and local knowledge, and the document libraries of various institutions needs to be determined.

As most of the data used for transboundary water resources management (both quality and quantity) is provided by national organizations, the data-sharing system should ideally be built to rely on national information systems with (direct) access to datasets made available by national partners. This implies a need to reinforce national capacities in data management and to develop capacities to share comparable data and ensure interoperability with the information systems of partners, using a common language and common procedures.

Lesson 16. Involve decision-makers in identifying the information needs from the beginning to ensure that the process is participatory and integrated with policymaking processes.

To ensure that decision-making in water management and water-using sectors is based on relevant information, decision-makers need to be involved to ensure that the information resulting from the monitoring system and the information that is shared is relevant for policymaking and facilitates informed decisions.

Case study 30. Supporting decision-making in the River Plata Basin

Lessons learned covered in this case study: Lesson 4, Lesson 16, Lesson 24, Lesson 31, Lesson 32

The River Plata Basin the second largest river basin in South America, and is shared between Argentina, Bolivia, Brazil, Paraguay, and Uruguay. The cooperation is done through the Intergovernmental Coordinating Committee of the La Plata Basin Countries (CIC CdP). The agreement between the governments is based on the La Plata Basin Treaty of 1969 [45], which creates the CIC Cuenca del Plata International organization, in the current Statute updated in 2001 [46], and the Internal Regulations updated in 2002 [47], which define the governance and operating rules of the organization.

The sharing of information is carried out voluntarily by the institutions responsible for information related to the waters of each country. Beyond this, the CIC CdP is implementing a Support System for Decision Making (SSTD) that allows the visualization and processing of information from different countries in a single interoperable platform (Delft-FEWS) within the framework of the project for the implementation of the CIC Strategic Action Plan [48], financed by the GEF. The stable operation of the CIC CdP is financed with contributions from the 5 countries. In addition, the countries agreed to implement Hydrometeorological Forecasting and Early Warnings System in the La Plata Basin (PROHMSAT) to enhance the capacities of the region's NMHSs for the provision of flood forecasting, decreasing the vulnerability of the surrounding communities against the impact of floods. [49]

The data is automatically integrated online into a common database on the configured Delft-FEWS platform. The institutions of the countries are the ones that make the data available for their country, and the ones that use the information system of the entire basin. These institutions oversee keeping the monitoring stations active, and the configurations made. The CIC CdP is the institution that hosts the system, oversees its maintenance, and coordinates the operation of the system as well as possible new developments, training and knowledge transfer.

The system update frequency depends on the data update frequency of each country. Hydrometeorological data is updated frequently, which varies between one hour and one day, depending on the update of the data of each country. Water quality data is updated monthly.

[45] https://cicplata.org/es/documentos/#1481142093532-099e3504-55cd

[46] https://cicplata.org/es/documentos/#1481159972214-a3dab81d-4760

[47] https://cicplata.org/es/documentos/#1481159970877-815b56d0-d69f

[48] "preparando las bases para la implementación del Programa de Acción Estratégica (PAE) de la Cuenca del Plata" https://cicplata.org/es/proyecto-implementacion-pae/

[49] https://community.wmo.int/en/projects/hydrometeorological-forecasting-and-early-warning-system-la-plata-basin-prohmsat

Data stored in national databases are temporarily centralized in a common database, the SSTD database. They are accessible to the public, and are easy to find and interoperable, but they are not yet reusable by downloading them. For the time being there are no joint reports, however periodic reports are expected to be made in the medium term.

The developed system has the objective of supporting decision-making by the decision-makers of each country who have also participated in its configuration. At this stage, the SSTD is mainly developed for expert technical users from the different countries, who, depending on the communication and decision-making strategy of each country, can use the SSTD as an additional input for decision-making.

The free access of interoperable data exchange was further improved through a project in 2018 supported by World Meteorological Organization (WMO) and its partners. Though this period, WMO Hydrological Observing System (WHOS) [50] was implemented with the benefits of mapping the different metadata used by different countries, brokering the different data formats through the WHOS DAB (Discover and access Broker), making the data freely downloadable though Water Data Explores (WDE). The data shared by the different data providers in La Plata basin are accessible, discoverable and can be downloaded though this portal. [51] The data providers in the La Plata River Basin established a regional center in Brazil where WHOS is operated and sustained.

Source: Case study provided by Juan Carlos Alurralde, Comité Intergubernamental Coordinador (CIC) de los Países de la Cuenca del Plata, 2022 and Washington Otieno, World Meteorological Organization (WMO), 2023

Lesson 17. Raise awareness of the importance of acting at a basin-wide scale.

Water management works best when the entire basin is considered. Any action should account for the effects on the entire basin and measures can then be taken at the most effective location and scale.

Case study 31. Design and pilot application of a transboundary monitoring scheme for the Prespa lakes basin

Lessons learned covered in this case study: Lesson 13, Lesson 17, Lesson 35, Lesson 39

The transboundary Prespa lakes basin is shared between Albania, Greece and North Macedonia. The Prespa lakes basin is known for its global ecological importance. Two main lakes form the basin, Great Prespa and Lesser Prespa. These water bodies face particular challenges as unsustainable human practices have resulted in the deterioration of the water resources. Among others, scientific research indicates alarming signs of eutrophication in both lakes. Successful protection and management of the freshwater resources and valuable ecosystems of the Prespa lakes requires cross-border collaboration to meet both ecological and human needs across the basin.

Over the past two decades, the trilateral cooperation initiated by the prime ministerial declaration in 2000 and consolidated with the international Agreement on the Protection and Sustainable Development of the Prespa Park Area signed by the three countries and the European Commission ten years later, has been strengthened and evolved. However, joint water planning, monitoring and effective water management still have a long way to go. Water monitoring systems are in place in all three countries of the basin. Nevertheless, the big picture is largely unknown, as the monitoring systems and methodologies applied in the different countries are not harmonized, even though they all comply with or approximate the European Union Water Framework Directive (EU WFD) requirements.

Good knowledge and a common understanding of the water resources' status and challenges at basin scale is the most fundamental step for the development of appropriate water management policies. Establishing a transboundary monitoring scheme that would provide valid scientific information at basin level is fundamental for wise water management planning in the Prespa lakes basin.

[50] https://community.wmo.int/en/activity-areas/wmo-hydrological-observing-system-whos

[51] https://tethys.inmet.gov.br/apps/water-data-explorer/

A concept note for a pilot project for a transboundary monitoring scheme was presented during the First meeting of the Working Group for Water Management. The Working Group was established in the framework of the Prespa Park Management Committee on 24 June 2022 to implement the 2010 Agreement on the Protection and Sustainable Development of the Prespa Park Area. The objectives of the pilot project are:

- Improvement of the cross-border water dialogue and exchange of information in the Prespa basin.
- Enhancement of scientific knowledge and understanding of the surface water resources status and main threats across the basin.
- Harmonization of water monitoring across the transboundary Prespa basin and setting a scientific basis for the assessment of status and the best planning of appropriate management measures.
- Promotion of EU water policy implementation in the Prespa basin which extends beyond the Community boundaries.

Source: Case study provided by Ylber Mirta, Ministry of Environment and Physical Planning, North Macedonia, 2022

Lesson 18. Ensure collection and sharing of the appropriate and necessary data and information for the entire basin and across the water cycle.

Where water management is done at the basin level, data and information are needed that cover the entire basin as much as possible. Moreover, the data and information as collected should look at the entire water cycle, ranging from meteorological data, soil moisture, and groundwater to run-off and evapotranspiration.

The monitoring system should provide information for all riparian countries to be able to act. This includes identifying the most indicative indicators of common concern, monitoring sites for bilateral data-sharing, and common templates/rules for data-sharing and harmonization of data. A specific working group (Lesson 8) and involvement of experts (Lesson 14) can provide substantive support to such choices. Specifying the needs of information production should support transboundary basin and aquifer systems management and the strategy for data production access and information production/dissemination should allow to match the needs.

The temporal and spatial scale for monitoring and data collection need to reflect the issues at hand. For instance, for large basins and aquifers, it may be rational to focus monitoring and data-sharing in areas of particular vulnerability, under high stress, critical from the transboundary viewpoint, or hotspot areas like industrial areas or areas with intensive agricultural activities.

Case study 32. Basin-wide information from the Upper Indus Basin Network (UIBN)

Lessons learned covered in this case study: Lesson 5, Lesson 17, Lesson 18, Lesson 33, Lesson 42

The International Center for Integrated Mountain Development (ICIMOD) is an inter-governmental knowledge center working in the Hindukush Himalayan (HKH) region shared by eight member countries (Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan). ICIMOD has established the Upper Indus Basin Network (UIBN). UIBN is a voluntary and neutral knowledge and research network of key stakeholders of the riparian countries who share the Indus basin, including Afghanistan, China, India, and Pakistan. The network aims to bring together the relevant government institutions, policy champions, development organizations, researchers, and academic institutions to collaborate and share new knowledge, experiences, challenges, and solutions, related to climate, cryosphere, water, hazards and vulnerability, and adaptation. It emphasizes the importance of data-sharing but given the geopolitical sensitivities in the region, data-sharing is not happening. The focus is more on knowledge and information sharing.

The network has its country chapters in all the riparian countries who meet periodically at the national level as well as at the regional level. The country chapters bring together diverse institutional members working in the upper Indus basin. The country chapters are headed by relevant government institutions like, Afghanistan National Water and Environment Research Centre (ANWERC), Yunnan University, China, Indian Institute of Geomagnetism, Mumbai, India, and Pakistan Council of Research in Water Resources

(PCRWR). Among many other institutions involved in the network and contributing to information and data-sharing are the Ministry of Energy and Water, Afghanistan, Chinese Academy of Sciences, Institute of Tibetan Plateau Research, Jawaharlal Nehru University, India, Pakistan Metrological Department, Water and Power Development Authority, Pakistan, and many others. The members from these organizations are nominated by their respective institutions. These member institutions do work together for joint intervention.

Since it is a voluntary and entirely neutral knowledge and research network, there is no formal agreement signed amongst the parties engaged. However, the forum has been established by the members with mutual consensus. The members have agreed on the scope of the network defining ten guiding questions, based on which the member countries would generate and share knowledge. The network has developed and endorsed a governance framework, that defines the purpose of the network, governance structure, scope, roles and responsibilities, meetings, and reporting mechanisms.

Initially, ICIMOD is coordinating and supporting the network with resources including finance to arrange meetings at the regional level whereas the country chapters are organizing the periodic country chapter meetings by themselves. International researchers working in the region, who provide valuable contributions on knowledge and information sharing, cover their own expenses to participate in the meetings. Relevant country chapters are expected to mobilize resources for any collaborative research interventions with other country chapters. The country chapters are discussing opportunities for joint funding proposals to support knowledge development catering to the regional knowledge gapes. ICIMOD is providing some funds for a few collaborative research interventions in India and Pakistan. The India and Pakistan country chapters are collecting the field data based on the standard data collection tool developed by ICIMOD. The study reports and research papers generated from these studies will be published jointly by both the country chapters and ICIMOD.

The information and knowledge sharing takes place during the network's periodic meetings – twice a year. In addition, experience and knowledge sharing among the country chapters at the national level occurs on a more frequent basis – once every few months. For any other specific collaborative or joint research interventions, the frequency may be different depending upon nature of the research and the research duration.

Meeting proceedings are shared on ICIMOD's web portal open for public to refer to. The data sets generated from the Sustain Indus initiative are hosted on Indus Knowledge Partnership Platform (IKPP) which has open access for public. The collaborative research studies are published in the form of assessment reports and open access journal articles [52, 53] and disseminated to wider audiences.

Source: Case study provided by Ajaz Ali, International Center for Integrated Mountain Development (ICIMOD), 2022

Case study 33. Pollution prevention in the Meuse and Scheldt River Basins

Lessons learned covered in this case study: Lesson 18, Lesson 24, Lesson 35

In 1999, the International Scheldt Commission (ISC) and the International Meuse Commission (IMC) decided to develop a tool for their respective river basin districts to ensure effective communication between the different states or regions in case of a pollution incident with transboundary risks. These systems have been named the Warning and Alert System (WAS) common to the two river basin districts of the Meuse and the Scheldt, both shared between France, Belgium and The Netherlands, with the Meuse district also extending to Germany and Luxembourg. [54]

In practice, each State or Region of the basins concerned has designated a Main Alert Centre (MAC) which has the role of being the main actor ensuring all communications at international level in case of water

[52] https://www.sciencedirect.com/science/article/pii/S0048969721021379

[53] https://www.researchgate.net/publication/341195860_Promoting_Science-Based_Diplomacy_in_the_Upper_Indus_Basin_through_a_Research_Network

[54] https://saameuseescaut-wasmaasschelde.be/

pollution with potential transboundary impact. In the event of an accident, the MAC of the country or region concerned uses the computerized warning and alert system tool to notify and communicate all relevant data to the MAC(s) of the countries or regions potentially affected by the pollution wave, following a strict procedure, with a copy to the International Commissions.

Whenever a sudden transboundary deterioration in the quality of the surface waters of the Meuse or Scheldt River basin district threatens its use and/or could threaten people, flora, fauna or the environment, the "Warning and Alert System" is triggered. A report on alerts is drawn up each year by the IMC or ISC, showing the evolution of accidental pollution in each basin and the characteristics of this pollution (Figure).

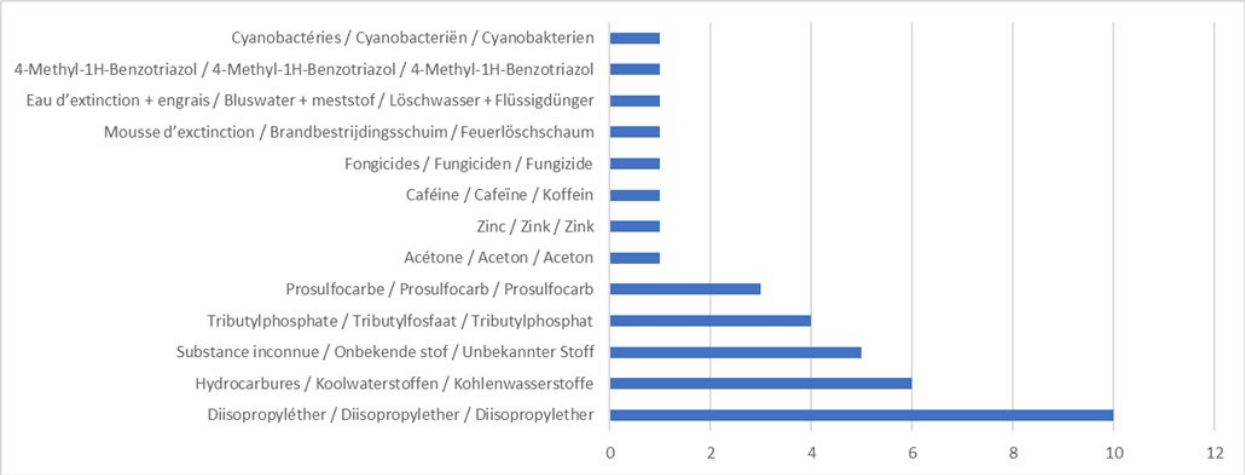


Figure: Overview of the causes of WAS notifications between 2021 and 2022 in the Meuse basin - Types of pollutants

Each year the WAS Meuse and the WAS Scheldt are both activated between 20 and 40 times, mainly for requests for information from a downstream country about a substance exceeding the standards.

Once a year the IMC and the ISC organize an alert exercise on a fictitious pollution, to allow the Main Alert Centres to use the tool and to prepare themselves for the conditions of a real pollution.

Source: Case study provided by Jean-Noël Pansera, International Meuse Commission (IMC), 2023

Lesson 19. Include information on groundwater and other water resources to promote conjunctive water management.

Conjunctive water management, managing surface water, groundwater and other components of the water cycle as a hydraulically connected system, helps to overlook possible interrelationships between the different components. Especially groundwater is often overlooked when it comes to water management, partly because groundwater is not very visible and difficult to monitor and manage. Nevertheless, groundwater plays an important role in many countries as, e.g., source for drinking water and water for agriculture. Also, groundwater can influence surface water availability and quality, and vice versa. Collecting groundwater information is therefore of great importance.

Case study 34. Groundwater information as part of the information sharing in the Gambia River Basin

Lessons learned covered in this case study: Lesson 18, Lesson 19

Various data sets have been identified and valued at the level of the OMVG and the Member States, targeting the following themes: hydrology, groundwater and aquatic biodiversity. The OMVG has a data visualization portal [55] produced with the support of the International Office for Water (OiEau). The following data is available there:

- Monitoring stations (village wells, boreholes, piezometers, limnimeters and virtual stations);
- Hydrological data;
- Piezometric data;

[55] https://www.aquacoope.org/gwh/fr/

- Hydrological data on virtual stations and uncertainties;
- Surface water quality data;
- Groundwater works;
- Indicators by infrastructure and/or basin;
- Land use;
- Networks (roads, railways, high voltage lines);
- Environmental DNA measurement points in the Corubal Basin.

In the absence of common repositories set up between countries, the harmonization of data is done on the fly during automatic import-export procedures such as ETL (Extract Transform Load). Data quality control remains under the responsibility of the data producers, the latter being invited to specify the quality control procedures put in place in their metadata sheets describing the data sets made available. The integration of data into the OMVG cross-border platform also allows additional quality controls due to the possibility of cross-analysis between the data made available by the countries.

The regular updating of the data is planned to be done as much as possible via its automated interoperability processes (ETL, API Web Service) between the information systems of the national producers (and/or the national information IS on the water) and the OMVG platform. These processes make it possible to consume/harvest data according to agreements and needs, and to automate access to data according to variable frequencies that can range from real time to daily/ten-day/monthly/annual frequencies).

The data is primarily stored in the databases of the data producers who remain responsible for their data, then possibly in the national information systems. Depending on the needs and authorizations, they can then be integrated into the framework of the OMVG platform. The data has different levels of access (public, private, restricted by password) depending on the case. Except in specific cases where a producer asks to respect the confidentiality of the data, most of the visualization products produced at the cross-border level are available online, accessible and downloadable by the public.

The establishment of the shared information system based on the information systems of the partners assumes above all an awareness raising/training of the national partners on the procedures of shared management. Moreover, as the water and environmental information systems of the countries concerned are at varying levels of development, it is important to build management capacities at the national level.

Source: Case study provided by Paul Haener, Office International de l'Eau (OiEau), 2022

Lesson 20. Support cooperation in a more flexible and effective way through inter-agency cooperation programs.

Developing inter-agency cooperation programs in support of intergovernmental agreements or even without such agreements may provide flexible instruments for cooperation. Such programs can be concluded for shorter periods of time and allow for adjustments when prolonged/revised for a new period.

Case study 35. Cooperation through inter-agency programs between hydromets in Central Asia

Lessons learned covered in this case study: Lesson 4, Lesson 20

In the region of Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan) there are bilateral cooperation programs between hydrometeorological services, typically concluded for a period of three years and renewed afterwards. These bilateral programs define the type, timing, frequency and method of transfer of information. They cover the exchange of actual meteorological, hydrological, and agrometeorological information and the exchange of information products such as weather forecasts, forecasts of water volumes, forecasts of reservoir volumes, warnings on extreme hydrometeorological situations, exchange of bulletins and reports. In addition to regular exchange of data and forecasts, such programs may also cover cooperation in research and development. For example, Kazhydromet (Kazakhstan) has a program of cooperation with Uzhydromet (Uzbekistan) which is renewed every three years. These agencies exchange hydrological information on 23 observation points in the territory of Uzbekistan and 12 observation points in the territory of Kazakhstan. This daily exchange covers water level and water flow, ice phenomena on rivers as well as data on water inflows, discharges and volumes of

reservoirs. Every three months, Uzhydromet provides Kazhydromet with the forecasts of water flow in the Amu Darya and Syr Darya basins for a month and a quarter.

Similar programs exist between Kazhydromet and Kyrgyzhydromet (Kyrgyzstan), and between Kazhydromet and Tajikhydromet (Tajikistan). In addition, Kazhydromet has a three-year bilateral program with Roshydromet (Russian Federation), covering daily exchange of hydrological data at transboundary rivers and volumes of reservoirs, as well as hydrological forecasts. Exchange of data on water quality is gradually developing in the region, particular between Kazakhstan and Uzbekistan in the Syrdarya River basin (since September 2018) and between Kazakhstan and Kyrgyzstan in the Chu and Talas River basins. Monitoring and exchange of monitoring results is also carried out on a regular basis in the basins of the rivers Ertis/Irtysh, Yesil/Ishim, Toyl/Tobol, Zhaiyk/Ural, Karaozen/Bolshoy and Saryozen/Maly Uzen, and Kigash/Kigach.

Source: Case study based on a presentation by Rauza Aschanova, Department of Hydrology of RSE Kazhydromet, 2023

Lesson 21. Apply citizen science to support collection of information.

The public at large can be mobilized to support data collection and analysis. This is called 'citizen science'. Volunteers can be provided with tools and knowledge to perform monitoring activities. The data collected by volunteers can constitute a substantial contribution to monitoring networks at relatively low cost. The volunteers, through these activities, become more engaged and more aware of the situation at hand and have improved capacities to be involved in decision-making. This also links to Lesson 9 to engage civil society and Lesson 15 to build on local knowledge.

Case study 36. Involving citizens in data collection: Drinkable Rivers

Lessons learned covered in this case study: Lesson 9, Lesson 15, Lesson 21, Lesson 36

When experiencing the beauty and health of a drinkable Rupert River and then returning to the Rupert River in Canada after three years and finding out that the water in the river was no longer drinkable as a result of dams and mining, Li An Phoa realized that drinkable rivers are an indicator of healthy living. Rivers can only be drinkable when all actions and relations in an entire watershed contribute. Having in mind that rivers are vital for all life on earth, she initiated the Drinkable Rivers movement. [56]

Drinkable Rivers, among others, runs an ambitious and all-round citizen science program. This program enables people to monitor the health of their rivers. It also helps us to track progress towards the goal of a world with drinkable rivers. There are currently 50 citizen science hubs in 18 countries. These hubs are run by enthusiastic people who mobilize volunteers around them to join. Most hubs are part of local environmental organizations, schools, visitor centers or companies. The hubs are provided with:

a) a professional, standardized measurement kit,
b) an introduction workshop and videos for ongoing support,
c) manuals and instruction videos,
d) a data platform for data-sharing and mutual learning.

Drinkable Rivers also mobilizes communities to act for drinkable rivers. These communities are led by inspired citizens, often water professionals, environmental activists, artists, businesspeople and politicians. [57] They are encouraged and assisted in the process and tools (action guides, courses, film) are developed to enable concrete action towards drinkable rivers.

Drinkable Rivers initiates river walks, walks along a river with local community members to engage with them and activate them to care for rivers. Central in all this is to use drinkable rivers as a societal compass with a guiding question: "Does this behavior, this measure, or this innovation contribute to drinkable rivers?"

[56] See https://drinkablerivers.org

[57] See, for instance, https://drinkablerivers.org/mayors-for-drinkable-rivers/

Source: Case study provided by Jos Timmerman on behalf of the Dutch Ministry for Infrastructure and Water Management, 2023

Further reading

UNECE, 2000. Guidelines on Monitoring and Assessment of Transboundary Groundwaters, available at https://unece.org/DAM/env/water/publications/assessment/guidelinesgroundwater.pdf

UNECE, 2014. Model Provisions on Transboundary Groundwaters. https://unece.org/info/publications/pub/21742

UNESCO, 2020. Conjunctive water management. A powerful contribution to achieving the Sustainable Development Goals, available at https://unesdoc.unesco.org/ark:/48223/pf0000375026.locale=en

4. Types of data and information shared

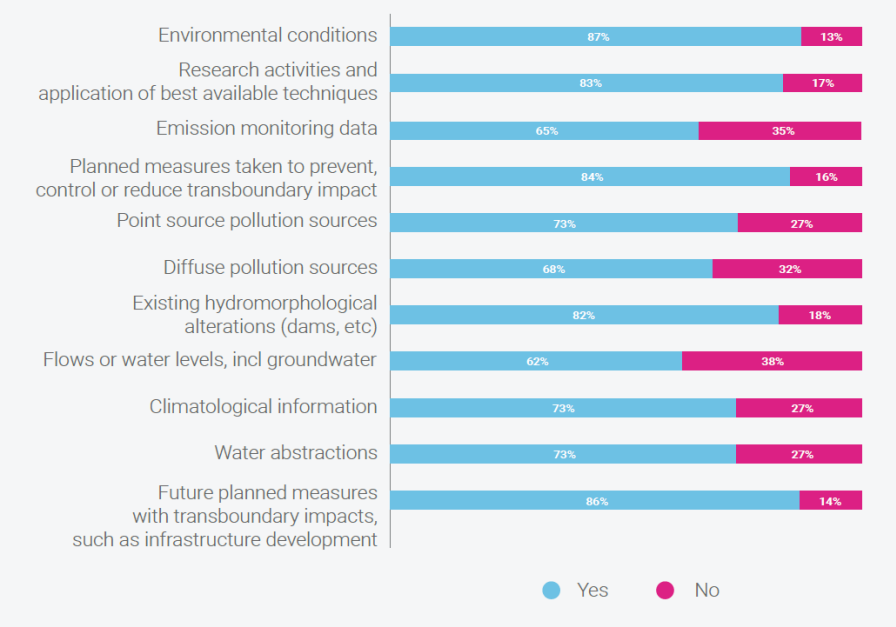
Riparian countries may exchange information on a variety of themes (see Figure below). Sharing of data and information requires agreeing upon what information is needed for informed decision-making. Agreement should be reached about the themes that will be part of the sharing and consequently what types of information are shared. This includes hydrometeorological information and water quality information but may also include information, for instance, about planned activities, legislative and regulatory measures, or dam operations.

For water management, in general, data and information is needed on the water uses (e.g. drinking water, irrigation, energy production, recreation, etc.) and functions (maintenance of ecosystems, protection of habitats and aquatic species) of the basin, the issues (e.g. flooding, sedimentation, salinization, pollution, morphological alterations and damming) that hinder the proper use and functioning of the watercourse, and planned and/or implemented measures taken to address the issues. Consequently, data and information may be needed and shared on, among others, the following themes:

e) Water flow, water abstractions
f) The environmental conditions of the waters (hydrology, water quality, meteorological data, etc.);
g) Best available technology;
h) Results of relevant research and development;
i) Measures taken and planned;
j) National regulations;
k) Critical situations (e.g., emerging floods or droughts).
l) Other data (population, socioeconomic, agricultural, land use, pollution sources, etc.)

Different sources exist for these themes and different types of data will come from the various sources. The data-sharing should account for such differences.

SDG indicator 6.5.2 reporting template, section II, question 6(d) – [If countries exchange data and information,] on what subjects are information and data exchanged?



Source: UN-Water, UNECE, UNESCO, Progress report on SDG indicator 6.5.2, 2021.

Lesson 22. Agree in the joint bodies to progressively enlarge the types of data and information collected and shared.

Basin commissions and other joint bodies for transboundary water cooperation are important in steering the level of cooperation. They can be instrumental in progressively enlarging the themes and types of data and information that are shared.

Case study 37. Working Group on Environmental Protection on the Chu and Talas River Basins

Lessons learned covered in this case study: Lesson 20, Lesson 22, Lesson 27, Lesson 35, Lesson 39

An agreement was signed between the Governments of the Kyrgyz Republic and Kazakhstan in 2000 on the use of water management facilities of intergovernmental status on the rivers Chu and Talas shared by these two countries. In 2006, a Commission on the Use of Water Management Facilities of Intergovernmental Status was established and in 2015 the 20th meeting of the Commission created the Working Group on Environmental Protection. The decisions of the working group are advisory in nature.

The Chu and Talas River basins are divided into the upper, middle and lower sections. In the upper and middle sections, water sampling and analysis are carried out by Kyrgyz authorities, such as Kyrgyzhydromet, the State Agency for Environmental Protection and Forestry Management, the Land Reclamation and Hydrogeological Expedition, and the Department of State Sanitary and Epidemiological Supervision of the Ministry of Health. In the lower section of the Chu River as well as the middle and lower section of the Talas River, water sampling and analysis are performed by laboratories of Kazhydromet.

Until 2019, water samples were taken by each Party separately within their own territory at different points in time. The Working Group concluded that it was essential to develop a coordinated surface water quality monitoring program. The Commission requested the Organization for Security and Co-operation in Europe (OSCE) for support to develop and implement the program. Since 2019, every year there have been four seasonal coordinated sampling campaigns. The sampling by Kyrgyzhydromet and Kazhydromet takes place in parallel at cross-border points at the same time (considering the time for water to travel to the sampling points from Kyrgyzstan to Kazakhstan). The sampling follows the same standard (GOST 31861-2012). The sampling points and indicators were agreed by Working Group members.

The created joint platform has supported the monitoring of the surface water quality in the river basins and increased cooperation between the countries.

The Chu and Talas example demonstrates how cooperation has gradually progressed over the years from joint maintenance of several water management facilities to other areas of cooperation, including water

quality monitoring and assessment. The role of the joint Commission and its secretariat has been crucial in this respect.

Source: Case study based on presentation by Gulmira Satymkulova, Secretariat of Chu-Talas Commission, 2023

Lesson 23. Develop procedures how to share data and information on planned measures.

In addition to general exchange of information on water quantity, water quality, pollution sources, geology and/or forecasts (hydrological, meteorological, hydrogeological and ecological), riparian countries should exchange information concerning planned measures and uses, i.e., planned developments. A procedure to share data and information on planned measures, including notification and consultations, can help to avoid mismanagement and prevent misunderstanding and disputes. [58]

Case study 38. ZAMCOM procedures for notification of planned measures

Lessons learned covered in this case study: Lesson 4, Lesson 23

In 2017, the Zambezi Watercourse Commission (ZAMCOM) Council of Ministers endorsed the Procedures for Notification of Planned Measures (Parts I and II), developed through a series of national consultations in the eight Zambezi Watercourse States. The duty to notify for ZAMCOM Watercourse States is stipulated in Article 16 of the Agreement establishing the Zambezi Watercourse Commission (ZAMCOM Agreement) and Article 4 of the Revised SADC (Southern African Development Community) Protocol on Shared Watercourses.

The Procedures consist of two parts, Part I being an introductory part highlighting the legal basis for the Procedures and the guiding principles, with Part II containing the detailed procedural rules and processes for carrying out a notification process in practice. The Procedures include detailed notification requirements, e.g., timelines, format, required supporting information, actions in absence of notification, etc., with the aim to ensure faster project development, approval and implementation and significantly reduce the possibility of disputes arising over planned projects. They also include the various forms to be used to ease and streamline the notification process. In addition, the Procedures clearly specify the roles of ZAMCOM bodies (ZAMCOM Council, ZAMCOM Secretariat, ZAMTEC, etc.) in the process of notification and consultations.

Since the operationalization of the Procedures (February 2017), they have been applied to a total of 16 planned measures in the Zambezi Watercourse: Botswana (2), Malawi (9), Mozambique (3), Namibia (1) and Zimbabwe (1). The planned measures include among others, water abstraction, irrigation projects, water supply and sanitation projects, development of resilient landscapes, instilling confidence and trust among riparian states and enhancement of transboundary cooperation.

One of the projects that will be implemented in accordance with the Procedures, is the Blantyre Water and Sanitation Improvement Project (BWSIP), which aims to address a range of challenges, including socio-economic development, sustainability and climate change adaptation. The BWSIP is a significant investment in the water sector of Malawi.

The Procedures for Notification of Planned Measures are an important tool for promoting the sustainable development of the Zambezi River Basin. They help ensure that planned measures are developed in a way that benefits all riparian states, promotes cooperation, protects the environment and reduces the possibility of disputes among riparian states. They help ensure that planned measures are developed in a sustainable and equitable manner.

Source: Case study provided by Hastings Chibuye, Zambezi Watercourse Commission (ZAMCOM), 2023

[58] This also relates to the principle of notification in international treaties. See, for instance, Article 13 of the Water Convention (https://unece.org/DAM/env/water/pdf/watercon.pdf).

Lesson 24. Develop a transboundary early warning system.

Early warning for floods, droughts and pollution events is of high importance for countries to be able to take timely measures. This may include increased frequency of sharing, additional themes and types of data to be shared, specific national authorities to be involved, etc. Timely provision of information in critical situations can save lives, prevent environmental damage, reduce pollution and limit transboundary impact. An early warning system in a transboundary basin is therefore of utmost importance.

Improved data and information that cover the entire basin improves the quality of forecasts including floods, low discharges that may influence irrigation possibilities or navigation, and pollution sources and accidental pollution. It enables improved long-term planning and, e.g., preparations for the agricultural seasons. Moreover, timely basin-wide information helps authorities and the public to prepare themselves to protect population and property and evacuate if necessary, reducing loss of lives (health and social impact) and livelihoods, damages (economic impact), and as well as impacts on environment and ecosystems.

Case study 39. Early warning systems in Georgia

Lessons learned covered in this case study: Lesson 12, Lesson 19, Lesson 24

Georgia shares terrestrial surface waters (rivers and lakes) with Turkey, Russia, Armenia and Azerbaijan and transboundary aquifers with Azerbaijan, Armenia and Turkey. The Protocol of Intention between the Ministry of Environmental Protection and Agriculture of Georgia and Ministry of Ecology and Natural Resources of the Republic of Azerbaijan, that was signed in Tbilisi on 15 December 2022, deals with the following:

- Exchange of information on the occurrence of dangerous hydrometeorological and geological events;
- Cooperation in the field of geology;
- Reassessment, monitoring, study of geological conditions of groundwater basins in border regions;
- Conducting trainings, workshops, sharing experience in the fields of geology, hydrometeorology and climate change.

This includes the exchange of information on radar meteorological data and early warning system, cooperation in the field of joint snow height measurement activities and preparation of joint forecast of the flow of transboundary rivers Mtkvari, Alazani and Iori. Also, the Protocol provides for the cooperation in the field of preparation and implementation of joint projects on climate change mitigation and adaptation.

According to the Protocol of the 12th session of the Intergovernmental Commission on Economic Cooperation Between Georgia and the Republic of Armenia that was signed in Yerevan on 12 January 2023, the Parties agreed to exchange the information on quantitative indicators of water in the Debed/Debeda river basin. „*Both Parties agreed to exchange the information on quantitative indicators of water in the Debed/Debeda river basin as well as ground surface meteorological stations and radar information; ambient air, water, and soil quality monitoring and assessment; management of natural resources*“.

There are no agreements/protocols on other transboundary rivers, such as Tusheti Alazani (Andes Koisu), Assa, Arghun, Tergi, Potskhovitskal, Psou, Chorokhi, lakes Kartsakhi (Kosefin) and Jandar.

Hydrological information is not public, but accessible (for students and educational structures). There is a hydrological database in the "AQVARIUS" program, which is constantly updated.

In March 2023, within the framework of the EU project “EU4Environment – Water Resources and Environmental Data” workshops were held in Tbilisi, for the purpose of the development of the transboundary monitoring of groundwater bodies. Armenian, Georgian, Azerbaijani and international experts participated in the meetings. Within the scope of competence, we consider it necessary to extend the cooperation in order to develop a program for joint monitoring of groundwater and to implement it.

Source: Case study provided by Salome Oboladze and Lasha Inauri, Ministry of Environmental Protection and Agriculture of Georgia, 2022

Case study 40. Development of Early Warning Bulletins in the Syr Darya and Amu Darya River basins

Lessons learned covered in this case study: Lesson 7, Lesson 24

The Scientific-Information Center of Interstate Commission for Water Coordination in Central Asia prepares the Early Warning Bulletins upon request of the United Nations Regional Centre for Preventive Diplomacy for Central Asia (UNRCCA). The Bulletin is to provide all the Central Asian states and their international partners with improved capacity to regularly monitor the status of transboundary rivers and warn early of potential issues that require attention. The Bulletin shows the actual situation in the Syr Darya and Amu Darya basins for the current month and the forecast for the next month. The following data sources are used in the Bulletin:

- Basin Water Organization "Amu Darya" and Basin Water Organization "Syr Darya" provide data on water resources, their distribution in time (daily) and by river reach, operation regimes of reservoirs, and inflow to the Aral Sea;
- Coordination Centre "Energy" provides data on operation regimes of hydroelectric power stations and electricity generation;
- Aral-Syr Darya Basin Water Administration provides data on components of the water balance from the tail-water of the Shardara reservoir to the Northern Aral Sea;
- Open Internet sources are used as sources of climatic information.

The Early Warning Bulletins can be found on https://unrcca.unmissions.org/early-warning-bulletins-2022.

Source: Case study provided by Iskander Beglov, Scientific Information Centre of Interstate Commission for Water Coordination in Central Asia (SIC-ICWC), 2023

Case study 41. Emergency pollution notification of transboundary waters shared by Moldova and Ukraine

Lessons learned covered in this case study: Lesson 4, Lesson 18, Lesson 24

Moldova and Ukraine share the Dniester and the Prut Rivers. They cooperate based on the intergovernmental Agreement of the Cabinet of Ministers of Ukraine and the Government of the Republic of Moldova on the joint use and protection of transboundary waters (1994) and the Treaty on Cooperation in the Field of Protection and Sustainable Development of the Dniester River Basin (2012). The Regulation on the assessment of the quality of transboundary waters ensures regular sharing of information on the quality of border waters. The two countries have agreed on state (national) monitoring programs and methods for evaluating results, to the extent necessary to obtain comparable measurement data on water quality indicators. Based on the data, it is possible to jointly assess the quality of border waters and trends in its change. The monitoring program for the quality of border waters includes monitoring sites and corresponding sampling points (gauges), sampling frequency, and analyzed water quality indicators.

In the event of emergency pollution of transboundary waters, there are additional requirements to monitoring and sharing of data and information. These are defined in the Regulation on actions during emergency pollution at transboundary rivers. In the event of emergency pollution, the Party where pollution originates must immediately notify the other Party. In addition, Parties must:

- Carry out additional water sampling and measuring of quality indicators;
- Share operational information on the volumes of discharge of pollutants;
- Timely provide information on changes in the quality of transboundary waters;
- Analyze the situation, develop an action plan to stop pollution and eliminate its consequences.

Source: Case study provided by Gavril Gilca, Environmental Protection Agency of Moldova, 2022

Case study 42. Flood forecasting in the Meuse River Basin

Lessons learned covered in this case study: Lesson 11, Lesson 12, Lesson 24

In December 2016, the Members of the International Meuse Commission (IMC) signed an agreement on data exchange and flood forecasting (also known as the IMC data exchange convention). This agreement

has enabled to set up a platform on which the States and Regions transmit raw precipitation measurement data (Figure 1), water level and flow measurements from 160 hydrological stations (Figure 2) as well as calculated forecasts of water level or flow on 60 stations.

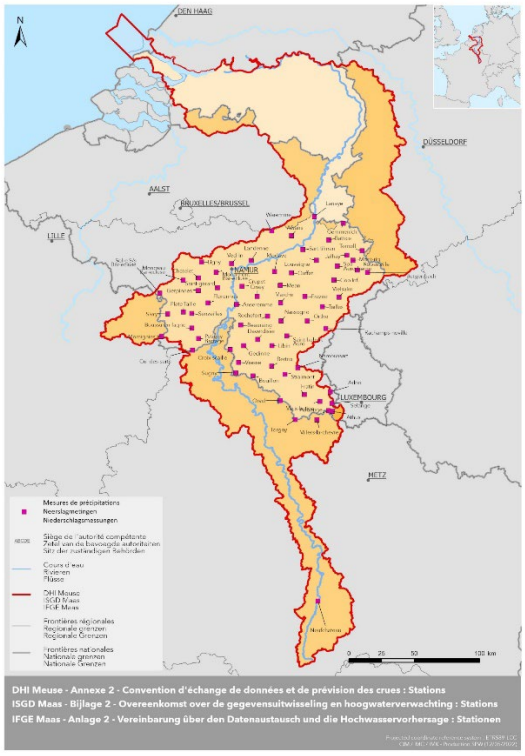


Figure 1: Precipitation measuring stations of the IMC data exchange convention

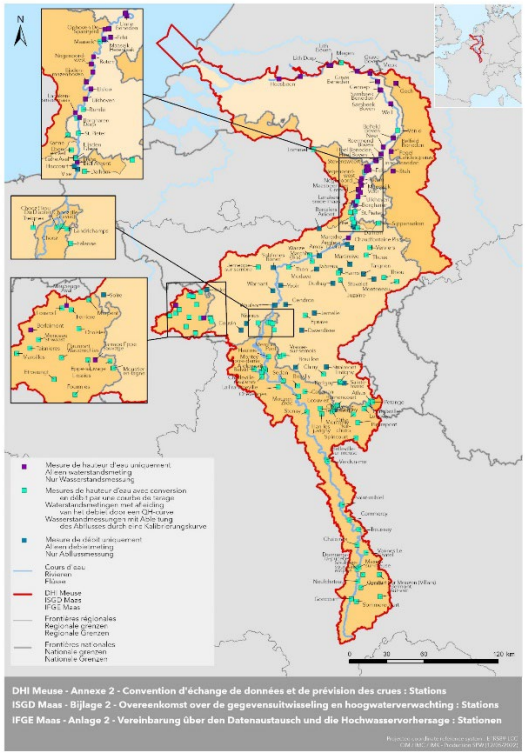


Figure 2: Water level and flow measuring stations of the IMC data exchange convention

During the catastrophic events of July 2021, a "cold drop" type weather phenomenon affected the Meuse basin. Due to the very erratic nature of the rainfall trajectory (Figure 3), the forecasting work of the Meteorological Institutes of Belgium (MRI) and the Netherlands (KNMI) was particularly difficult in terms of location and water quantities. For example, the MRI weather forecasting models predicted less than 200 mm of precipitation in the Vesdre and Amblève catchment areas (tributaries of the Meuse), whereas the actual precipitation reached almost 300 mm. As a result, the flood forecasting services in the international Meuse basin also had difficulties in forecasting the hydrological impact of this rainfall. By relying on the network of IMC precipitation measurement stations, the flood forecasting services of the downstream states were able to feed their hydrological models with precipitation data measured in France and Wallonia, but also with water level and flow data from stations located on the Meuse and its tributaries.

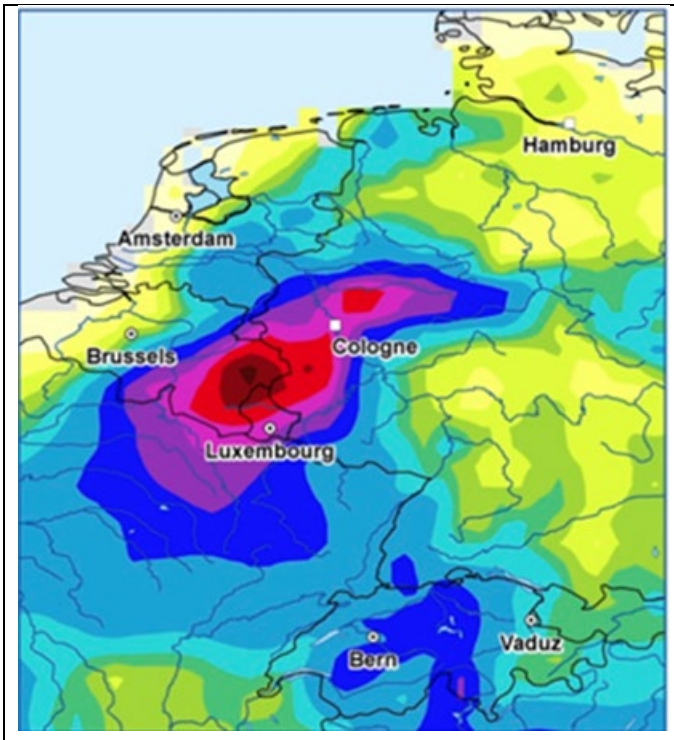


Figure 3: Cumulative rainfall recorded from 13 to 14 July 2021

With this data, the Dutch flood forecasting services were able to refine their forecasts as the weather events unfolded. The Dutch models predicted a flow of between 700 and 900 m3/s on 12 July for the St. Pieter station located downstream of the border with Belgium, then a maximum flow of 2,750 m3/s on 13 July. This enabled the authorities to evacuate the populations located in the risk areas from 14 July onwards (around 50,000 people) and to take protective measures (opening of dams, raising of dykes with sandbags and sheet piles - figures 4 and 5).

Figures 4 and 5: Examples of flood protection in the Netherlands in July 2021

The exchange of data between the States and Regions of the IMC has enabled the national authorities to estimate the expected flood level in the downstream areas as accurately as possible and to take all the necessary measures to protect people and property, both by evacuating people from flood-prone areas and by protecting property by raising dikes, flooding non-populated areas or opening dams.

Source: Jean-Noël Pansera, International Meuse Commission (IMC), 2023

Lesson 25. Expand traditional national monitoring to transboundary level and promote the use of innovative monitoring technologies.

Monitoring at transboundary level is necessary for proper management of basins. Existing monitoring systems are an important source of data and information. Technological innovations can help to collect data and information at lower costs. Such innovations include Earth Observation systems, remote sensing and drones, Geographical Information Systems (GIS), self-monitoring by the private sector, citizen science, sensors, and environmental DNA.

Further reading

UNECE, 1993. Guidelines on the ecosystem approach in water management. https://unece.org/info/publications/pub/21714

UNECE, 1995. UNECE Task Force on Monitoring and Assessment: Biological Assessment Methods for Watercourses. https://unece.org/info/publications/pub/21698

WHO-Europe, 2011. Policy guidance on water-related disease surveillance. https://unece.org/info/publications/pub/21732

WHO-Europe, 2011. Technical guidance on water-related disease surveillance. https://unece.org/info/publications/pub/21733

UNECE, 2018. A nexus approach to transboundary cooperation: The experience of the Water Convention. https://unece.org/info/publications/pub/21761

UNECE, 2018. Words into Action Implementation Guide for Addressing Water-Related Disasters and Transboundary Cooperation. https://unece.org/info/Environment-Policy/pub/21762

5. Harmonization and quality assurance

Sharing of data and information entails harmonization of methods and formats to ensure that the data and information are comparable and can consequently be used by other organizations. Next to that, the data and information need to be of good quality, which requires a process of quality assurance.

To facilitate the comparability of data, clear agreements should be made between neighboring countries on the definition, coding and formats of collected data and supporting information. In addition, collected data should include “metadata” such as the date, location, measuring depth and measured values. Data quality control is needed for the detection of outliers, missing values and other obvious errors.

Lesson 26. Harmonize data to facilitate comparability between countries.

Each country generally uses its own methods to collect, compile and analyze data. Because of such different methods, data from similar locations may deviate. It is therefore important to harmonize the data to make them comparable. Harmonization can be done by adopting the same (international) standard for each parameter but can also be done by making a ‘translation’ that indicates how the different values should be interpreted. For chemical analyses, laboratory intercalibration activities help to harmonize the data. Moreover, a common procedure for data and information sharing is needed to ensure that the data and information as collected by different parties remain comparable.

The riparian countries also need to have comparable capacities to share data and information. This includes interconnecting the partner information systems to ensure interoperability, using a common language (common concepts and a referential dataset) and common procedures.

Case study 43. Development of a hydrological cycle observation system in the Nile River Basin

Lessons learned covered in this case study: Lesson 12, Lesson 18, Lesson 23, Lesson 26, Lesson 31, Lesson 36

The Intergovernmental Authority on Development-Hydrological Cycle Observation System (IGAD-HYCOS) [59] was implemented by World Meteorological Organization (WMO) in collaboration with IGAD from 2011 to 2017 funded by the European Commission (EC). The project was implemented in Nile Basin Countries [60] (Burundi, Djibouti, Ethiopia, Kenya, Rwanda, Somalia, South Sudan, Sudan and Uganda) with the exception of DR Congo. IGAD-HYCOS aimed at establishing a hydrological information system that would contribute to the production of decision-making tools and relevant information products needed by policymakers and users of hydrological services.

During the preparatory phase of the IGAD-HYCOS, major gaps in monitoring networks, data management, advocacy, and capacity building were identified as prioritized areas for project implementation. Within the five years the project established a data-sharing protocol where all countries committed to share data to the regional database to be used for generating common regional products. Redistribution of data at the regional center was only possible through authorization from the data provider, while the products and services were to be freely available. By 2017, the regional database was receiving data from over newly installed 70 real time observing stations from 7 countries and all countries were using the regional server as shared infrastructure operation and/or system backup. The basic hydrological observation infrastructure was improved though provision of 198 stations (122 surface water and 76 groundwater stations), rehabilitation and construction of stations sites. These sites were identified based on their key locations by Member states to perform in-situ measurements necessary for validating the space observations.

The project was designed around the national activities and providing needed resources such as funds, vehicles etc. to support their inclusion in the national plans and resources. The regional database is currently hosted by the IGAD Climate Prediction and Applications Centre (ICPAC) but some additional funds are needed for maintenance of the stations. All site constructions, installation of stations, national databases were all carried by national staff from the region with assistance from some international staff.

Ample attention was paid to capacity development through several trainings that were conducted in installation of stations, gauge reading, data management and web portal management, etc. The training model used was very effective where a group of selected experts from each country were trained on site until they understand then they went and conducted the same task in their countries while training in their countries.

The project established an outreach programme to children (developed a comic “Amina” explaining about water using comics), visits by university students, and engagements with relevant water ministers. In addition, a regional web portal was established to reach out to large audience which was updated regularly with all the relevant materials and links to social media project pages, like Facebook.

Source: Case study provided by Washington Otieno, World Meteorological Organization, 2023

Lesson 27. Ensure regional coordination and technical cooperation.

Coordination and technical cooperation between riparian countries is needed to ensure that data and information are generated and available in a compatible and harmonized format that is in accordance with agreed parameters and methodologies. International cooperation partners may provide support in this.

Case study 44. Cooperation in monitoring of the transboundary basins between Kazakhstan and China

Lessons learned covered in this case study: Lesson 4, Lesson 8, Lesson 27

Cooperation between Kazakhstan and China in the use and protection of transboundary rivers is based on the principles of justice and rationality, as well as from the position of sincerity, good-neighborliness and friendship.

The main cross-border rivers between the countries are the Black Irtysh (Kara Ertis), Ili (Ile), Emel, Khorgos, Sumba, Tekes, and Ulken-Ulast.

[59] https://hydrohub.wmo.int/en/projects/IGAD-HYCOS

[60] https://www.nilebasin.org/index.php/nbi/who-we-are

Water relations between the Republic of Kazakhstan and the People's Republic of China are regulated by the *Agreement between the Government of the Republic of Kazakhstan and the Government of the People's Republic of China on cooperation in the use and protection of transboundary rivers*, signed in Astana on September 12, 2001. To implement the Agreement, the *Kazakhstan-China Joint Commission on the use and protection of transboundary rivers* (hereinafter - the Joint Commission) and its working group of experts were established.

According to the Agreement, in the area of monitoring of transboundary basins, the Parties will take appropriate measures and make efforts to prevent or mitigate possible serious damage caused by flood disasters and man-made accidents. The Parties may cooperate on negotiation and definition of the locations of observation stations and measuring the volume and quality of water, research on common methods of observation, measurement, analysis and evaluation; analysis and completion of hydrological observation and measurement data at posts agreed by the Parties; conduct possible joint research to prevent or mitigate the effects of flooding, glaciation, and other natural disasters; study trends in future changes in the water content and quality of transboundary rivers; if necessary, conduct joint research and exchange of experience in the use and protection of transboundary rivers.

The Parties also agree on and determine the content, quantity and time of data and information exchange. Hydrological information (data) includes average daily water levels, water flow, water temperature, and ice events over the past year. The exchange of hydrological information (data) is made in hard copy, in English, according to the approved format for transmitting information (data).

Annual meetings of the working group of experts of the Joint Commission exchange information (data) on 10 hydrological stations (6 Kazakh stations and 4 Chinese stations) located on the main transboundary rivers - Irtysh, Ily, Emel and Tekes.

The Parties signed an *Agreement between the governments of the Republic of Kazakhstan and the People's Republic of China on water quality protection of transboundary rivers* in Beijing on February 22, 2011. Within the framework of this Agreement, the Parties cooperate in conducting joint research activities to determine and agree on water quality standards for transboundary rivers acceptable to both States, monitoring rules and methods of their analysis; to conduct monitoring, analysis and assessment of water quality and exchange agreed information on their results.

In order to coordinate and implement this Agreement, the *Kazakh-Chinese Commission for cooperation in the field of environmental protection* was established. Within the framework of this Commission, a *Working group on monitoring, analysis and assessment of the water quality of transboundary rivers* and a *Working group on rapid response to emergencies and prevention of pollution* have been established. The working groups hold at least one meeting each year in accordance with the schedule.

Source: Case study provided by Kulpash Zhaken, International Water Assessment Center (IWAC), 2023

Case study 45. Coordination and cooperation in the International Commission for the Protection of the Rhine (ICPR)

Lessons learned covered in this case study: Lesson 11, Lesson 18, Lesson 27

The water quality of the Rhine is monitored from Switzerland down to the Netherlands. This is done by the ICPR member states and their nine monitoring stations along the Rhine with the help of an international coordinated measuring program. For a successful international monitoring the following components must be considered: (1) common objectives, participating monitoring stations, a net of monitoring stations and the scope of the measurement; (2) a common data collection, completeness check and plausibility check; (3) evaluation and assessment of the data as well as their documentation. In concrete terms, this means, for example, that the list of substances, which are relevant for the Rhine, is updated every three years by an expert group of the ICPR. The main monitoring stations are then obliged to measure these substances. Once per year all the data is collected, checked and published with the help of the German Federal Institute of Hydrology. Every three years the expert group prepares a report about the data and the water quality of the Rhine.

The cooperation at the Swiss-German border (Basel/ Weil am Rhein) as well as at the German-Dutch border (Bimmen/Lobith) is remarkable. In Weil am Rhein it is one monitoring station, which is jointly financed by Germany and Switzerland. In Bimmen/Lobith there are two monitoring stations located close to each other, but at different shore sides and one in Germany and one in the Netherlands. The laboratories of these monitoring stations are in one place for close collaboration and information exchange.

Source: Case study provided by Tabea Stötter, International Commission for the Protection of the Rhine (ICPR), 2023

Lesson 28. Harmonize and integrate the use of models with measurements.

Models can support decision-making as they allow to extrapolate certain events. Nevertheless, models need to be calibrated against observation data to ensure that the model provides accurate information. A combination of measurement data and models can thus help to provide relevant information. In case different models are used by the different countries, harmonization of the models is needed (see Lesson 26).

Case study 46. The OKACOM Decision Support System

Lessons learned covered in this case study: Lesson 4, Lesson 18, Lesson 26

The Okavango River Basin is shared between Angola, Botswana and Namibia. The countries have statistical agencies which are the primary national institutions mandated with documenting, storing and distributing national data.

The OKACOM Data Sharing Procedures is the instrument and agreement for data-sharing among Member States. Data-sharing has been going on since 2020 based on this agreement which also led to the establishment of the OKACOM Environmental Monitoring Framework. Each Member State finances all data collections as per its usually departmental activities. International Cooperative Partners (ICP) also support from time-to-time joint data collection and basin-wide monitoring which contributes greatly to data on ungauged streams.

The data-sharing procedures set some quality assurance principles. The OKACOM Decision Support System ensures that data will be stored in a consistent format from all Member States and at the same time provides a platform for harmonization of national databases both in data format, technology and systems used for Hydromet-gauging and data storage. The need to continue to expand this harmonization has been identified. Data is commonly shared as raw data files, paper/report, and provision of information service especially in the form of flood bulletin. Bi-annual for raw hydrologic data, daily for flood product services over a period of three months/active flood and ad hoc or per availability for all other.

The process is not fully developed but the common database is linked to the OKACOM DSS. Despite strong data interoperability, the accessibility by the public is limited. There are joint reports, depending on the regularity of joint activities. Decision makers are informed through direct information sharing and at OKACOM statutory meetings which happens twice a year.

Information is posted on the OKACOM Website, but the DSS will have a dashboard section providing information to the public through web. Also, through community visit programs information is shared.

Source: Case study provided by Phera Ramoeli, Permanent Okavango River Basin Water Commission (OKACOM), 2022

Case study 47. Water balance data reconciliation on Lake Fertő

Lessons learned covered in this case study: Lesson 4, Lesson 29

Based on the agreement between the Republic of Austria and the Hungarian People's Republic on the regulation of water management issues in the border region of 9th April 1956, hydrological data is shared. The hydrological data is produced and processed by Hungarian and Austrian institutes that are funded

from the central budgets of the Hungarian government and Burgenland federal government. The parties provide their data to each other free of charge.

Hungarian and Austrian water management institutes jointly process and share the time series of annual hydrological data. Water level, water discharge, precipitation, and evapotranspiration time series of the numerous hydrological monitoring stations on lake Fertő and its watershed are evaluated annually. Water balance data is processed by each side, and it's been evaluated during a joint meeting.

The partners send each other the hydrological and meteorological data needed for the water balance throughout the year. Accordingly, both parties can calculate the water balance using all necessary data available for Lake Fertő catchment. The calculated water balance is jointly evaluated and improved as necessary.

Hydrometeorological elements of the water balance (water levels, water discharges, precipitation time series, evapotranspiration data) are stored in MS Excel form, the printed form of the summarized results are an appendix of the minutes of the common Hungarian-Austrian Committee. Each partner stores the data in their own database (in Hungary it's called Hydrographical database [VRA]). The processed data of the Hungarian stations is free of charge for researchers, students or any non-commercial use. The Hungarian partner is not allowed to publish or provide the Austrian data for any use.

Joint minutes are drawn up in both languages, that summarize the work done. These minutes are made annually. Decision makers are informed about this evaluation annually, which is a part of the annual meeting of the joint Hungarian-Austrian Committee.

Source: Case study provided by Peter Kovacs, Ministry of Interior, Hungary, 2022

Lesson 29. Perform joint monitoring for harmonization.

Harmonization can be achieved by doing joint monitoring on the same stretch of the river or at the same well or borehole. This may result in a joined dataset, or the countries can do separate processing and analyses to compare the results, which enables understanding possible differences between the results of the different countries.

Case study 48. Joint monitoring in the Dniester and Prut River Basins by Ukraine and Moldova

Lessons learned covered in this case study: Lesson 4, Lesson 26, Lesson 29

The Regulation of Ukrainian-Moldovan Cooperation on Monitoring the Quality of Border Water ensures regular sharing of information on the quality of border waters in the Dniester and Prut basins. The two countries agree on state (national) monitoring programs and methods for evaluating results, to the extent necessary to obtain comparable measurement data on water quality indicators, based on which it is possible to jointly assess the quality of border waters and trends in its change.

The Parties share test reports containing the data of physical and chemical analyzes for the past period during the joint selection, approved at the end of each calendar year for the next year based on the results of joint sampling of transboundary waters. Each party assumes financial obligations to ensure the presence of laboratory staff at the joint selection, where the exchange of data for the previous period is carried out.

The monitoring program for the quality of boundary waters includes the monitoring sites and corresponding sampling points (gauges), sampling frequency, and analyzed water quality indicators. Locations for monitoring the quality of boundary waters are selected based on national capabilities for organizing observations, and they are, as a rule, located on joint sections and boundary gauges of watercourses that form the State Border between the Parties.

At the agreed monitoring sites, sampling points (targets) are planned, because they enable obtaining adequate information about the background quality of the boundary waters. Information about the monitoring site, point (altitude) of sampling is drawn up in the form of a sampling protocol. The unified format for the protocol of the monitoring point (range) is agreed by the Parties.

The agreed list of indicators of the quality of border waters reflects those parameters that are important for the protection of water use in the border sections of rivers, have a pronounced nature of transboundary pollutants, and are subject to dynamics depending on the intensity of anthropogenic

activities in the watershed. By agreement of the Parties, specific lists of water quality indicators may be established for individual watercourses, reflecting the specifics of the watercourse, its water use or pollution features.

Sampling is carried out by the relevant Competent Authorities and other state (national) organizations nominated for this purpose, performing regular observations of the state of the waters, according to national programs, including simultaneously or jointly. For each sample, a protocol for sampling and the results of analytical measurements is filled out.

Analyses of the water quality parameters are carried out by state (national) laboratories certified and accredited in accordance with the accreditation procedures established in each of the Parties. The Parties strive to the extent possible to harmonize methods, rules, procedures for sampling and analytical work to increase the convergence of results.

Data is stored in the internal database of the water quality laboratory. Data-sharing is carried out in paper form in the form of a bulletin. Data-sharing using e-mail or other means of communication is allowed.

The Working Groups of each of the Parties, on the basis of their own data on the quality of border waters received during the calendar year, compile annual information in accordance with the form of the annual national report and submit it to the Plenipotentiaries of Moldova and Ukraine (joint body under the 1994 Agreement of the Cabinet of Ministers of Ukraine and the Government of the Republic of Moldova on the joint use and protection of transboundary waters) for approval at their next meeting.

Source: Case study provided by Gavril Gilca, Environmental Protection Agency of Moldova, 2022

Further reading

UNECE, 1996. UNECE Task Force on Monitoring and Assessment: Quality Assurance. https://unece.org/info/publications/pub/21701

UNECE, 2002. UNECE Task Force on Laboratory Quality Management and Accreditation. Technical report: Guidance to operation of water quality laboratories. https://unece.org/info/publications/pub/21696

WMO, 2017. Guide to the Implementation of Quality Management Systems for National Meteorological and Hydrological Services and Other Relevant Service Providers. https://library.wmo.int/index.php?lvl=notice_display&id=15574

WMO, 2021. Manual on the WMO Information System (WMO-No. 1060): Annex VII to the WMO Technical Regulations. https://library.wmo.int/index.php?lvl=notice_display&id=9254

6. Data management, processing, and sharing

Data needs to be stored, analyzed, and processed. Where data and information are shared, this includes potentially harmonizing assessment methods and modeling. Also, lessons learned on how the sharing of data is arranged and what issues come up there.

Data should be stored properly in databases, with sufficient supporting information to enable interpretation, comparison, processing (conversions, etc.) and reporting. For the data analysis, an agreed (statistical) operation is needed. This includes, for instance, testing against standards. Most of the data used for transboundary water resources management is provided by national organizations. Therefore, the transboundary information system should ideally be built to rely on national information systems with (direct) access to datasets made available by national partners. This implies a need to reinforce national capacities in data management and to develop capacities to exchange comparable data and ensure interoperability with the information systems of partners, using a common language and common procedures. Formats for the exchange of data should be defined and agreed upon by the users.

Lesson 30. Technical cooperation can be a springboard for multi-disciplinary cooperation.

Cooperation at the technical level can be a way to showcase the importance of cooperation. The resulting information from such cooperation, that may not require a formal mandate, can show the benefits of the

cooperation and also show knowledge gaps that are essential for proper decision making. This may lead to involvement of other disciplines at the technical level to close the gaps. When this is recognized at the political level, formal mandates can be developed, and cooperation can be expanded.

Case study 49. Sharing of data and information in the study of the Pretashkent Transboundary Aquifer

Lessons learned covered in this case study: Lesson 7, Lesson 11, Lesson 12, Lesson 19, Lesson 28, Lesson 30, Lesson 32, Lesson 40

The Pretashkent Transboundary Aquifer is an example of a medium-sized deeply buried artesian aquifer [61] with negligible recent recharge. It is shared between Kazakhstan and Uzbekistan. There are two main challenges associated with the aquifer: 1) Depletion of groundwater storage and 2) Potential degradation of groundwater quality.

The Governance of Groundwater Resources in Transboundary Aquifers (GGRETA) project, implemented by UNESCO-IHP, in close partnership with IGRAC and national counterparts and with support of the Swiss Agency for Development and Cooperation (SDC), aimed at strengthening regional stability, cooperation and peace through the establishment of cooperative frameworks for transboundary groundwater governance. The Pretashkent Aquifer was chosen as one of three pilot aquifers in three different continents.

The first phase of the GGRETA Project (2013-2015) provided a scientific and multidisciplinary understanding of the groundwater dynamics, legal and institutional frameworks as well as socio-economic conditions. [62] The second phase of the project (2016-2018) focused on building institutional capacity on transboundary water cooperation and strengthening dialogues between Kazakhstan and Uzbekistan. The aim was for the countries to agree on a pathway towards cooperation on the joint management of the Pretashkent Aquifer, while ensuring that the exchange of data would align with national requirements of security. The recommendation was to establish teams of national experts to create and operate a mathematical simulation model, to be used by national government institutions as a basis for groundwater management and for developing a consolidated strategy for Kazakhstan and Uzbekistan to manage the risk of degradation of the aquifer. A mathematical simulation model of the aquifer was subsequently created as part of the project's third phase (2019-2022) along with three scenarios for future management of groundwater resources of the aquifer. Building upon this technical cooperation, a strategy to support sustainable use and management of the Pretashkent Aquifer and continued cooperation was developed by Kazakhstan and Uzbekistan, in the form of a joint roadmap. The roadmap was endorsed on 30. November 2022 by the Geology Committee of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan and the State Committee for Geology and Mineral Resources of the Republic of Uzbekistan.

Next steps include:

1. Make the model a permanent operational tool for aquifer management across the two states.

2. Build capacity for international cooperation on the optimal joint management of groundwater resources based on agreed scenarios, the permanent operational model, and exchange hydrogeological monitoring data.

3. Ensure on-going monitoring of the groundwater resources in all operating wells, regardless of their affiliation and purpose. Assess and monitor the technical and environmental condition of water intake wells.

4. Improve national legislation to ensure mandatory groundwater monitoring of the aquifer.

5. Limit the extraction rate in intake wells in strict accordance with the values of exploitable resources agreed and approved by the countries.

[61] An artesian aquifer is a confined aquifer containing groundwater under positive pressure. An artesian aquifer has trapped water, surrounded by layers of impermeable rock or clay, which apply positive pressure to the water contained within the aquifer.

[62] https://www.un-igrac.org/sites/default/files/resources/files/Pretashkent_web.pdf (in Russian).

6. Ensure the development of an accounting system for the volume of groundwater abstraction and use at the national and interstate levels, and a regional water cadaster (a database) to register groundwater abstraction across the aquifer. The database would be used as a main input to the aquifer management model.

7. Upgrade the state of groundwater monitoring system by installing modern equipment for recording the discharge rates and pressure in wells. Implement data quality control measures in accordance with international standards. Develop groundwater quality monitoring programs covering the entire aquifer.

8. Develop international cooperation between Kazakhstan and Uzbekistan on the groundwater quality of the aquifer, agree on water quality assessment standards and develop an arrangement for the exchange of this type of data between the states.

Source: Case study based on presentation by Oleg Podolny, "KazHYDEC" Ltd. and Valentina Rakhimova, U.M. Akhmedsafin Institute of Hydrogeology and Geoecology, Kazakhstan, 2023

Lesson 31. Build a common repository for the data, database, or information system.

A common repository has the advantages to support data harmonization and to arrange accessibility, among others. Clear arrangements are needed to ensure proper operation and maintenance of the repository. Preferably, the repository should be housed by the coordinating body (joint body) for the shared basin.

Case study 50. The Drin Information Management System

Lessons learned covered in this case study: Lesson 17, Lesson 31, Lesson 35, Lesson 39

The Drin is a transboundary river basin shared by four countries (Albania, North Macedonia, Greece, and Montenegro) and Kosovo. [63] It provides water resources for drinking, energy, fishing, agriculture, biodiversity, tourism, and industry. Although the national authorities in the basin collect a lot of complex data, they have limited access to these national data, which is neither collected nor stored in a harmonized manner by all. This had been recognized as an obstacle to transboundary cooperation, so, in 2011 the Ministers from the five riparian countries signed a Memorandum of Understanding (MOU) where they agreed that one of the priority actions to address this concern is the "improvement of information sharing through the establishment of a system for regular sharing of relevant information among competent authorities of each party".

The GEF Drin Project (implemented by UNDP and executed by Global Water Partnership - Mediterranean (GWP-Med) in cooperation with the Water Convention Secretariat has supported the implementation of the MoU since 2016. As a result, several preliminary analyses of the Drin basin's environmental situation were made and following the Expert Working Group for Monitoring and Information Sharing advice, the Drin Core Group (DCG) decided to design a tool that would satisfy the need to store and share comprehensive scientific data on the Drin basin level. After two years of data collection from national institutions and careful software design, the Drin Information Management System was born. It is developed as a GIS based free online tool available in all Drin languages that allows for easy collection, sharing and presentation of data concerning the Drin basin environment, societies and economies. Designed in a user-friendly way, the Information Management System [64] is an invaluable tool to transboundary cooperation. It is currently maintained by the Secretariat of the DCG (GWP-Med) and administered by the representatives of the Drin riparian countries.

Additionally, responding to the need of establishing transboundary monitoring, the GEF Drin project supported a pilot activity implemented in cooperation with UNESCO aiming to design and test a modern multi-purpose transboundary groundwater monitoring network in the Skadar/Shkoder – Buna/Bojana Delta transboundary alluvial aquifer (Albania and Montenegro) in line with relevant EU legislation. The results will be used to upscale related activities at the Drin Basin level.

[63] United Nations administered territory under Security Council Resolution 1244 (1999).

[64] https://dringis.org

Source: Case study provided by Ylber Mirta, Ministry of Environment and Physical Planning, North Macedonia, 2022

Lesson 32. Use models for assessment, interpretation, and forecasting.

Models provide the possibility to extrapolate data geographically. This enables a better assessment and interpretation of the data which is especially important for integrated aquifer systems. Models can also extrapolate data towards future events under various circumstances, enabling forecasting of potential events. In this way, models can, among others, be used to forecast the effects of measures.

Case study 51. The Rhine Alarm Model

Lessons learned covered in this case study: Lesson 18, Lesson 24, Lesson 28, Lesson 32

After the fire in the chemical plant at Sandoz near Basel in 1986 during which great amounts of extinguishing water contaminated with chemicals flowed into the Rhine, the 7th Conference of Rhine Ministers charged the International Commission for the Protection of the Rhine (ICPR) to elaborate a Rhine Alarm Model in collaboration with the International Commission for the Hydrology of the Rhine basin (CHR) for the Rhine and its main tributaries. After sudden discharges of pollutants, this model can calculate the development of the wave of pollutants. Since the Sandoz accident, during numerous sudden pollutions, it has proven to be an indispensable instrument within the international Warn- and Alarm Plan (IWAP) Rhine.

Within the IWAP, reliable predictions of sudden pollutant waves are extremely important for a timely implementation of required measures at the right time. Among such measures are halting the intake of raw water for drinking water production or having the fire brigade or civil protection put up oil barriers in the Rhine or its tributaries. The flow time model (alarm model) for the Rhine is used by the international main warning centers, the national warning centers, the warning centers of the German Länder and the institutions consulting these centers (e.g., operators of monitoring stations) and the drinking water companies to predict the substance distribution of a sudden water pollution event.

The flow time model for the Rhine is a model of the Rhine from Lake Constance to the North Sea. In addition to the main river, the tributaries Aare (draining the majority of Switzerland), Neckar, Main, Moselle, Meurthe and Saar are mathematically modelled. Model calibration was carried out using particular pigments (tracers) that do not harm aquatic organisms which were discharged into the Rhine and are measurable in very low concentrations. When required, place, time and amount of pollution, substance breakdown, floatability of substances (e.g., oils, gasoil, petrol), discharge and/or water levels serve as model input.

The model will then calculate the concentration of a substance for the observed river location depending on time, the time of the peak of the pollutant wave at the location observed and the development of the pollutant wave from the discharge location to the North Sea. This model can predict not only the development of a pollutant wave downstream but the spreading of a pollutant cloud over the width of the river. For selected periods of time (in general one day), this model can calculate where the wave will be in the watershed. If required, an animation may demonstrate the development of the pollutant wave from the discharge location until the North Sea. The development of the pollutant wave can be predicted with about 98 % reliability.

The flow time model for the Rhine served as a basis for developing similar models for the Danube and the Meuse.

Preparations are currently underway for a new or updated Rhine flow time model.

Source: Case study provided by Tabea Stötter, International Commission for the Protection of the Rhine (ICPR), 2023

Further reading

WMO 2021. Manual on the Global Data-processing and Forecasting System (WMO-No. 485): Annex IV to the WMO Technical Regulations. https://library.wmo.int/index.php?lvl=notice_display&id=12793

7. Reporting and use of data

Reporting should be based on an interpretation of the data and plays a key role in decision-making for water management and the further development of monitoring and assessment programs. It is therefore important that the reporting and use of the data and information is defined as part of the development of the overall monitoring network.

Reporting is not limited to producing a report but also entails all types of dissemination. Information about water resources contributes to environmental reporting and may inform planning relevant for water-using sectors. Information dissemination should take place on a regular basis, and the interpreted data should be made available in an easily accessible and understandable manner tailored to the audience being addressed. The same information should be ready to be used for a variety of purposes, including different reporting obligations, and by a variety of users. The level of detail included in reports and the frequency of compilation also depend on the target audience.

Reporting of environmental information plays an especially important role in increasing public awareness of water problems, climate change and biodiversity impacts, and in promoting public participation in water management. The form of a joint report for the purposes of water management in transboundary basins should be agreed upon in detail by the riparian countries. Reporting may take place through a joint body, e.g., the joint body may be entrusted with the development of reports. Harmonization of reporting is strongly encouraged. The information produced must be used and should contribute to management decisions.

The use of information should feed back into the design of the monitoring program, leading potentially to revision and improvements, as well as to the review of and possibly changes in information needs and consequent priorities for monitoring and assessment.

Lesson 33. Disseminate information to all relevant sectors, ministries, and the public.

To ensure support from sectors, ministries, and the public, it is important that they are informed on the outcomes of monitoring. The reports should provide ministers and other decision-makers with relevant information to support informed decision-making but also reiterates the importance of monitoring each time the minister receives relevant information. Also, between different stakeholders and the public at large, sharing of information is beneficial and can initiate and improve public participation. Note that the information as disseminated should be based on documented and agreed evidence.

Case study 52. Stakeholder participation in the International Commission for the Protection of the Rhine (ICPR)

Lessons learned covered in this case study: Lesson 9, Lesson 11, Lesson 33

For the benefit of the Rhine and of all waters running into the Rhine, the members of the International Commission for the Protection of the Rhine (ICPR) – Switzerland, France, Germany, Luxemburg, the Netherlands and the European Commission successfully co-operate with Austria, Liechtenstein and the Belgian region of Wallonia, as well as Italy.

Additionally, intergovernmental organizations whose work is related to the ICPR Convention and non-governmental organizations, as far as their areas of interest or tasks are concerned, can be recognized as observers to the ICPR. The observers participate in meetings of expert and working groups, in the plenary assembly and in a yearly meeting with the ICPR president. The observers do not have the right to vote but they share information and receive information from the ICPR. In some groups they actively contribute to reports. One example of the contribution of stakeholders is the yearly published report about messages send over the International Warning and Alert Plan (IWAP). The drinking water associations are receiving

information about contaminations in the Rhine over the IWAP, so they can stop using Rhine water for drinking water abstraction. For the yearly report the International Association of Waterworks in the Rhine Basin (IAWR) is providing information about withdrawal stops, which is published as one chapter of the report.

Source: www. Case study provided by Tabea Stötter, International Commission for the Protection of the Rhine (ICPR), 2023

Lesson 34. Ensure the sharing of knowledge between technical specialists and decision-makers.

By actively disseminating results of monitoring to decision-makers there will be a growing understanding of the situation in the basin at the policy level, which can lead to better informed decisions.

Case study 53. Information system in the Aral Sea Basin and a weekly newsletter

Lessons learned covered in this case study: Lesson 20, Lesson 30, Lesson 34

There are five Central Asian states within the Aral Sea basin: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan.

The Scientific-Information Center of the Interstate Commission for Water Coordination in Central Asia (SIC-ICWC) prepares information and analytical reviews on the state of water resources and their forecast, compares operational forecasts and actual data on the use of water resources and river water balances of the main rivers of the region to be used by national agencies and other stakeholders, among other things – on request. The reviews are based on mathematical calculations and modelling. Analytical reviews facilitate integrated assessment of the water management situation in the basins of the Amu Darya and the Syr Darya rivers and their sections.

The SIC-ICWC has created the Regional Information System on Water and Land Resources in the Aral Sea Basin (CAWater-IS) (http://cawater-info.net/data_ca) with access granted to the ICWC members and their authorized organizations.

The available online system offers a user interface with integrated databases. The CAWater-IS is stored on the SIC-ICWC portal. Most of the information is open to users, about one third of the information (national data) is disclosed upon official requests. Analytical information is provided on a contractual basis.

The SIC-ICWC disseminates a weekly newsletter "Water Sector, Irrigation, and Ecology in Eastern Europe, the Caucasus, and Central Asia", published once a week in Russian (also posted on the website at http://cawater-info.net/news/index.htm). It contains information about key events in the region in the field of water management, land reclamation, ecology, power generation, as well as (every ten days) analytics on the water management situation in the Amu Darya and the Syr Darya river basins. The reports are publicly available in the ICWC Bulletins (http://www.icwc-aral.uz/icwc_bulletins_ru.htm). Reports within the framework of joint projects are published in open sources. All periodicals are regularly shared with the ICWC members, ministries and agencies, as well as ICWC partners within and outside Central Asia.

The SIC-ICWC and its national branches should be financed in what concerns developing and maintaining an information system at the expense of contributions to the International Fund for Saving the Aral Sea (IFAS), with the costs shared by the five countries proportionally to the volume of water resources used. In reality, the activities of the central offices of the Basin Water Organizations “Amu Darya” and “Syr Darya” and the SIC-ICWC are funded by the Republic of Uzbekistan as a contribution to the IFAS. Other financing sources are also used (projects, grants, etc.). Obtaining data takes place under contracts with hydrometeorology services against payments. Statistical bulletins are purchased from sectoral authorities.

Source: Case study provided by Dinara Ziganshina, Scientific Information Center of the Interstate Commission for Water Coordination in Central Asia (SIC-ICWC), 2022

Lesson 35. Have the information as collected serve the purpose of better management through cooperation.

Monitoring information as shared should help to build a good understanding of the situation in the basin at hand. Where there is common information, agreements can be made on the management of the water in the basin, ensuring that the water is used in an equitable and sustainable way.

Case study 54. Data-sharing for improved water management in the Oder/Odra River Basin

Lessons learned covered in this case study: Lesson 4, Lesson 8, Lesson 23, Lesson 35

The Oder/Odra River Basin is shared between Poland, Germany and the Czech Republic. All data exchange within the framework of the International Commission for the Protection of the Oder River against Pollution (ICPO) [65] takes place through the Secretariat of the ICPO. The delegation spokespersons in the G5 Working Group "Data management", who represent institutions such as the State Water Holding, Polish National Water Management Authority, Warsaw, the Ministerstvo životního prostředí ČR (Ministry of the Environment of the Czech Republic) and the Landesamt für Umwelt of the Land of Brandenburg (State Environment Authority) are responsible for the transfer of data within the ICPO.

The G5 Working Group "Data Management" within the ICPO deals with all data-related issues for the needs of the ICPO. Its tasks are included in the mandate, among others:

- Data management for the needs of the ICPO, in the scope of:
    - collecting, maintaining, updating and sharing data relevant to the work of the ICPO,
    - development and implementation of conceptual assumptions for the development of the ICPO data set and the necessary tools,
    - developing and implementing conceptual assumptions for the consistent presentation and publication of information about the activities of the Commission and the results of its work on the website of the ICPO, with particular emphasis on the development opportunities of the GeoPortal.
- Cooperation with groups and subgroups of the ICPO in the field of:
    - analysis and visualization of data necessary for the implementation of tasks under the responsibility of the groups and subgroups of the ICPO, especially in relation to works under the Water Framework Directive and the Floods Directive,
    - use of GIS in the conducted works,
    - advising on technical issues relating to the provision of information on the activities and products of the groups and subgroups of the ICPO.

At the ICPO level, the exchange of data and information is free of charge.

For each update of the Water Management Plan for the International Odra River Basin District (RBMP for MODO), monitoring data (measurement points and assessments) are provided by the spokespersons of the delegations in the G5 "Data Management" Working Group to the Secretariat of the ICPO in order to develop joint maps and statistics. This takes place every six years in accordance with the requirements of the Water Framework Directive. This includes:

- part II, chapter 2.2 "List of emissions, discharges and losses of all priority substances and pollutants in accordance with Article 5 of Directive 2008/105 / EC
- part II, chapter 4 "Monitoring networks and the results of monitoring programs".

The GM Working Subgroup "Monitoring" is responsible for providing data to the IMS-Odra module and has agreed that at the end of each year, GM delegation spokespersons will submit the required data (physico-chemical and biological parameters) for the previous year's measurement points to the Secretariat for individual monitoring stations. These data will then be processed by the Secretariat and uploaded to the module. Data is often reported with varying degrees of detail which requires further clarification with individual delegations. A GIS Specialist is employed in the ICPO Secretariat, who verifies all the data provided and, in case of doubts regarding their quality, contacts the spokespersons of the

[65] https://www.mkoo.pl/index.php?lang=EN

delegations in the G5 Working Group. The data is transferred by e-mail in the form of an excel file or shp files.

All data submitted to the Secretariat is contained in the data set of the ICPO. It includes all digital spatial data (including relevant documents) that were needed or will be needed in the future for the implementation of joint international tasks of all contracting parties to the ICPO. The databases are not available to the public. Issues related to their disclosure are regulated by the "Terms of use/sharing of data from the ICPO data sets", which can be found on the ICPO website. Year reports are published online. [66]

The data is presented on the ICPO Geoportal [67] as well as in the International Water Management Plan for MODO and available to the public on the ICPO website.

Source: Case study provided by Przemysław Susek, Regional Unit of Environmental Monitoring in Zielona Góra, 2022

Lesson 36. Develop a shared communication plan.

Dissemination of data and information is important to support informed decision-making. Especially in a transboundary data and information sharing situation it is important that the messages from the reporting are agreed upon by the riparian countries. A shared communication plan can help to streamline the results from the shared data and information. The communication plan should define what audiences should be reached and what their needs are in terms of information. The subsequent information products and messages should be tailored to the needs of the different audiences. Different audiences will require different channels and instruments (tables, reports, infographics, presentations, etc.) to convey the messages. Appropriate instruments should be selected for each audience.

Data and information need to link to the needs of the audiences. Any dissemination of data and information therefore reaches best its audience when the presented data and information tell a story. This goes beyond merely presenting the data and information coming from the monitoring system.

Lesson 37. Establish mechanisms for regular review of the monitoring system.

Information needs will change over time as a result of technological possibilities, new insights and emerging problems. As a result, the monitoring system may not provide all the relevant data. To ensure that the data and information from the monitoring system remains relevant, a mechanism should be established to regularly review if the information that the monitoring system provides is still relevant and if new or other information may be needed. Based upon the review, it can be decided if the monitoring system needs to be adapted. The adaptations may include different or additional parameters, locations, and frequencies but also different analytical methods. None of the case studies have described specific mechanisms for regular review, but, for instance, Case study 26 and Case study 56 show that such reviews take place.

Further reading

JRC, 2023. Global Drought Observatory. https://edo.jrc.ec.europa.eu/tumbo/gdo/map/

UNECE, 2011. Second Assessment of Transboundary Rivers, Lakes and Groundwaters. https://unece.org/info/publications/pub/21808

8. Impacts and benefits

Data and information sharing has benefits and leads to impacts in the cooperation and in the water management situation. Benefits and achievements of data-sharing may include:

[66] https://www.wasserblick.net/servlet/is/110115/?highlight=deutsch-polnisch

[67] http://geoportal.mkoo.pl/IKSO/client/gisclient/index.html?&applicationId=2385

- Mutual support in establishing a monitoring system, developing a joint approach to the future proposal of measures,
- Optimization of activities through e.g. joint capacity building, implementing a shared database and drafting joint studies;
- Agreement on monitoring parameters and methods, and harmonization of results from chemical, ecological and biological analysis of water from agreed monitoring stations;
- Improved basin-wide, transparent, harmonized, "neutral" and reliable information, and data leading to greater technical and scientific understanding of the entire basin as the basis for better management of water bodies;
- Improved forecasting, impact assessment and dissemination of results for better decision-making;
- The development of regular reports such as impact studies and state of the basin reports;
- Improved early warning through the availability of continuous monitoring results to detect contaminations in time for intervention, as well as for flood forecasting and disaster risk management, including successful coordination and cooperation during flooding events;
- Improved understanding of the distribution of a basin's water resources and water balance, enabling the setting of environmental flows, better control and operational rules for the basin and sub-basins, and efficient water supply to parties involved;
- Shared concepts of pressures and impacts providing a common ground for cooperation, offering a platform for dispute settlement and improved trust and confidence among riparian states, their institutions, citizens and Indigenous people, as well as enhanced cooperation.

Lesson 38. Have data and information serve as the basis for conflict prevention.

Presenting data and information in a transparent and meaningful way can help to agree on the situation as it is. Where there is consensus about the issues and problems, discussions can focus on solutions and the way forward.

Case study 55. Preventive diplomacy in the Guaraní Aquifer System

Lessons learned covered in this case study: Lesson 7, Lesson 10, Lesson 17, Lesson 20, Lesson 31, Lesson 38

The Guaraní Aquifer System is the largest transboundary aquifer system in Latin America, covering an area of approximately 1,100,000 km^2 and shared between Argentina (21%), Brazil (68%), Paraguay (8%), and Uruguay (3%). In 2010, a formal international agreement on the cooperation on aquifer system was adopted by the four countries, the Guarani Aquifer Agreement (GAA), which subsequently entered into force in November 2020. It refers, as the first international treaty on transboundary aquifers, in its preamble to the UN International Law Commission Draft Articles on the Law of Transboundary Aquifers. [68] The agreement is an example of preventive diplomacy, without antecedent transboundary conflicts over the use of, or impacts on, groundwater.

During 2003-2009, a USD26 mill project (Guaraní Aquifer System Project, GASP) funded by GEF and the four states, produced a transboundary diagnostic analysis [69] and a Strategic Action Program (SAP) for the joint protection and sustainable development of the aquifer. [70] A significant amount of joint assessment took place as part of the GASP, including the implementation and development of the GAS monitoring network. Smaller pilot projects enabled the sharing of local data, and a joint database, the (SIGAS), for the entire aquifer was established. A follow-up GEF-funded project currently under development (Implementation of the Guarani Aquifer Strategic Action Program: Enabling Regional Actions), which has as its core objective to support the implementation of the SAP and the operationalization of the agreement, has the aim to consolidate and expand the monitoring network and associated data-sharing. [71] There are currently no formal arrangements for regular exchange of data and information.

[68] https://legal.un.org/ilc/texts/instruments/english/draft_articles/8_5_2008.pdf

[69] https://iwlearn.net/resolveuid/81988aa912c2f9844b25cbb1d4594b0e

[70] https://www.oas.org/DSD/WaterResources/projects/Guarani/SAP-Guarani.pdf

[71] https://www.riob.org/sites/default/files/5.%20Lucia%20Samaniego_Guarani.pdf

A precursor for the operationalization and coordination of the cooperation, and for the onward data and information sharing, is the establishment of the joint commission for cooperation on the aquifer, prescribed in the treaty and based on the framework of the La Plata Basin Treaty. The four countries have begun to discuss how the commission will be formed but have not yet reached an agreement.

The new project will address the following categories of issues:

- Institutionalizing mechanisms for a strengthened transboundary cooperation among GAS countries
- Enabling countries to detect the evolution in time and space of key quality and quantity parameters of the Guaraní waters at both the regional and local levels
- Fostering gender equality as part of the proposed project and of the SAP itself
- Reinforcing capacities and increasing awareness

The second component establishes the "Design and field pilot testing of regional monitoring networks and protocols", the purpose of which is to respond to the need for reliable periodic information from wells in order to produce regional datasets on water quality and quantity, similarly to what is being done at national levels, but in a coordinated and standardized way.

Currently, within the framework of the development of the new project, a workshop is planned to discuss the issue of data storage and exchange. There are several possibilities, and the countries will have to decide what kind of platform they will use to share their information.

Source: Case study provided by Karen Villholth, Water Cycle Innovation based on reports by the Regional Centre for Groundwater Management in Latin America and the Caribbean (CeReGAS - Centro Regional para la Gestion de Aguas Subterraneas America Latina y el Caribe), Uruguay, 2023

Case study 56. Dialogue to address pressing challenges in the Genevese Aquifer

Lessons learned covered in this case study: Lesson 19, Lesson 28, Lesson 34, Lesson 35, Lesson 38

The Genevese Aquifer is shared between France (10%) and Switzerland (90%). It is a specific example of cooperation at transboundary level with the involvement of local entities. The cooperation relates to a managed aquifer recharge (MAR) scheme serving nearly 700,000 people in the border region between the two countries, which requires the continuous monitoring and management of the groundwater resources, due to natural as well as artificial recharge and discharge (pumping) processes. The responsible institutions for data collection and sharing are the Canton of Geneva and the two French territorial units (Annemasse Agglo and the Communauté de Communes du Genevois).

The mandate for data and information sharing is implicit in the Convention on the Protection, Utilization, Recharge and Monitoring of the Franco-Swiss Genevese Aquifer which entered into force in 2008. The cooperation on the Genevese Aquifer goes back much longer, with a first agreement signed back in 1978. Also in 1978, binational committee, the Geneva groundwater Committee, in charge of groundwater exploitation was set up to regularly review the state of the resource. The committee gives advance notice on all matters submitted to it in connection with the management and protection of the aquifer.

With respect to data and information transmission, each riparian institution is responsible for its own funding, as for any work on its territory. At annual meetings of the Geneva groundwater Committee, information on groundwater levels and well pumping and MAR data is provided.

Water analyses are carried out by laboratories specific to each party, while the supervisory and verification bodies of each party are in contact with each other and apply the same accreditation from the point of view of chemical analyses. The Canton of Geneva has a database (GIS), which holds a lot of data related to groundwater quality and quantity and environment, as well as a website (open for the public).

The vehicles for internal data/information sharing include reports, data files, online platforms, direct transmission, depending on the topic and the type and purpose of exchange (plenary meeting, specific working group meeting, etc.). Exchange occurs at minimum annually (plenary meetings) but may be more frequent in the event of technical working group meetings or on an ad hoc basis (telephone exchanges). There is a specific work site (SharePoint) for the Geneva groundwater Committee, in which the common elements related to the management and protection of the aquifer are available to the members, improving the knowledge for both countries.

The information and the monitoring of hydrogeological data have a valuable impact in terms of understanding the flow of the aquifer, its hydrogeological limits and ultimately the protection of the aquifer. A better overview makes it possible to determine the importance of the different flows and the reasons for pollution in certain parts of the aquifer. These considerations have environmental, financial, and necessarily social consequences for drinking water.

The Genevese Aquifer is internationally recognized for its transboundary resource management agreement between the Swiss and French local authorities, described as the first groundwater management agreement in the world. Signed in 1978 and renewed in 2008, this agreement on the management of a shared underground resource has long been an example for the establishment of other agreements throughout the world, in particular by the UNESCO and its Intergovernmental Hydrological Programme and by the Transboundary Aquifer Commission of the International Association of Hydrogeologists.

Like many countries around the world, Switzerland and France are experiencing critically dry summer for the past few years. Water management in the Greater Geneva cross-border basin experienced complicated episodes, with both surface and groundwater availability decreasing, triggering water use restrictions. In this context, the Genevese Aquifer is becoming a fallback resource for the concerned area.

The system applied in the cross-border agreement for the use of the aquifer involves local French authorities' participation in the costs of managing the resource and the MAR scheme, depending on the total pumping.

Given this situation, the French local authorities formally asked the authorities of the Canton of Geneva to review the conditions and calculation methods linked to the quotas of the 2008 agreement. In the fall of 2022, a cross-border working group was established, to work on the current and future observation of the resource and on the financial arrangements related to the management and protection of shared groundwater from the Genevese Aquifer. Substantial work on better knowledge of the resource in order to calibrate a digital model of groundwater management is at the centre of these discussions, which should lead to a revision of the terms of the agreement. A new agreement will be a good example of adaptation in cross-border cooperation, to address the differences in the management of a shared resource resulting from the impacts of climate change.

Source: Case study provided by Karen Villholth, Water Cycle Innovation based on reports by the Republic and Canton of Geneva, Department of Territory (DT), Office Cantonal de l'Environnement (OCEV), Service of Geology, Soil and Waste (GESDEC), 2023

Lesson 39. Enable improved water management through data and information sharing.

Improved basin-wide data and information strengthens the scientific understanding of the shared water and thus enables reduction of current and future degradation trends. These in turn can help to develop a transboundary vision and joint strategic action plans, thus improving management decisions on how to safeguard the environment and which socioeconomic activities to promote. It demonstrates how responsible development ensures environmental sustainability and at the same time can enhance social justice and economic development, especially among riparian communities. It helps to advance in a coordinated and integrated management of the water resources and contributes to transparency of decisions.

Case study 57. Improved water management in the Rhine River

Lessons learned covered in this case study: Lesson 2, Lesson 11, Lesson 16, Lesson 39, Lesson 40

The beginnings of advanced industrialization during the second half of the 19th century and the rapid extension of industrialization after the foundation of the German Empire in 1871 were characterized by the creation of numerous craft undertakings and factories as well as rapid industrial growth. However, environmental awareness had not yet developed. Irrespective of eventual harm caused, the wastewater of the many factories along the Rhine and its tributaries were discharged into the river without any prior treatment. The increasing pollution of the Rhine with organic and inorganic waste gave rise to tensions between the bordering states. So, in 1950, the International Commission for the Protection of the Rhine

(ICPR) began its discussions on issues of Rhine protection and monitoring with a view to finding joint solutions. Mutual confidence had to be carefully created in the international working groups of the ICPR.

The high pollutant loads and the contamination of the Rhine with salt were of great concern for the downstream users. After the Sandoz accident in 1986 and with increasing public environmental awareness, the ICPR experienced years of intensive and successful work.

Within a short time, three Conferences of Ministers were staged, leading to the adoption of the Rhine Action Programme in 1987. Its target was to improve water quality to such an extent that formerly indigenous species, such as salmon, would be able to return to the river. A consequence of the Rhine Action Programme was that requirements concerning municipal and industrial wastewater treatment plants became distinctly stricter and a third treatment stage was introduced to eliminate phosphorous and nitrates discharge. The first survey in 1992 already gave evidence of a considerable reduction of pollutants. At the same time, the entire ecosystem was supposed to be enhanced together with the improved chemical water quality and flora and fauna were to be strengthened.

Nowadays, water quality has improved so much that it is, e.g., no longer an obstacle to salmon resettlement. Now that the massive loads of, for example, nutrients and heavy metals (see Figure below) have been reduced, reduction efforts can focus on micropollutants.

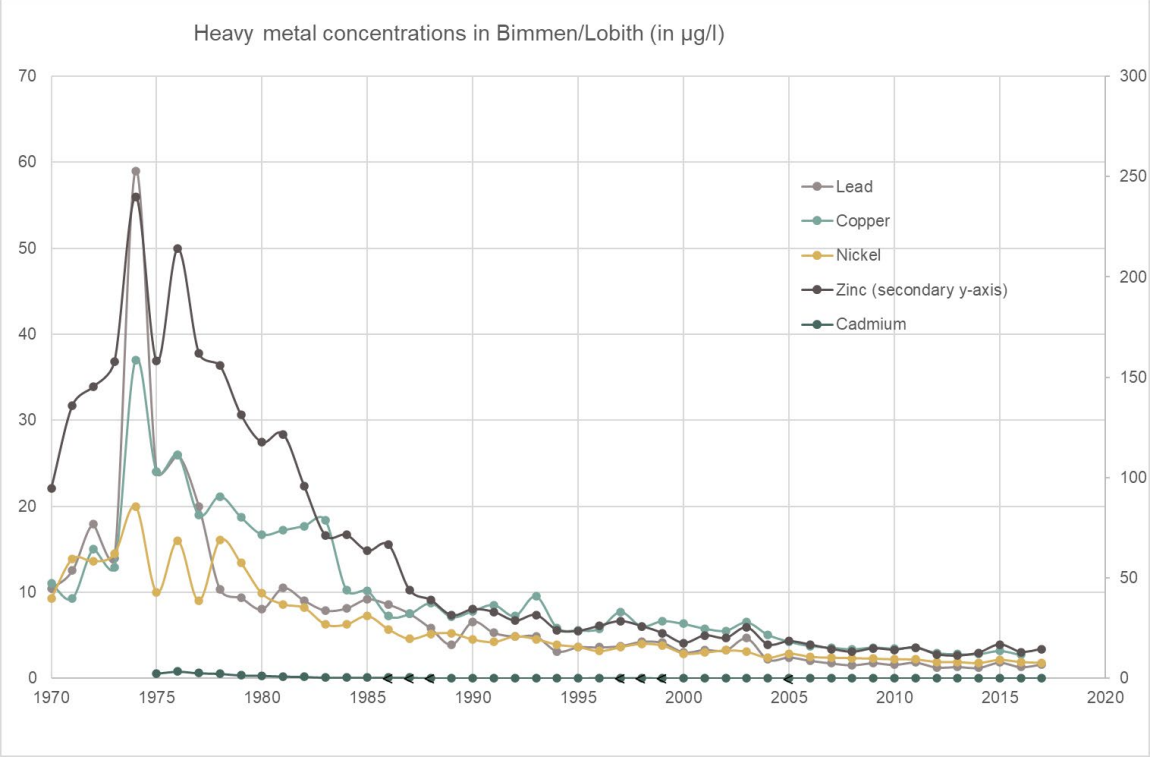


Figure: Concentrations of heavy metals 1970 – 2017 in Bimmen/Lobith

Source: Case study provided by Tabea Stötter, International Commission for the Protection of the Rhine (ICPR), 2023

Case study 58. Benefits from cooperation in the Sava River Basin: the perspective of Bosnia and Herzegovina

Lessons learned covered in this case study: Lesson 4, Lesson 11, Lesson 12, Lesson 35, Lesson 39, Lesson 40

Bosnia and Herzegovina develops its transboundary cooperation on the basis of:

- 1996 Agreement between the Government of the Republic of Croatia and the Government of Bosnia and Herzegovina on the regulation of water management relations. [72]

[72] Official Gazette of Bosnia and Herzegovina, number 6/96 - International Agreements

- 2015 Agreement between the Council of Ministers of Bosnia and Herzegovina and the Government of the Republic of Croatia on the rights and obligations of using water from public systems for water supply across state borders. [73]
- 2002 Framework Agreement on the Sava River Basin.
- 1994 Convention on Cooperation on the Protection and Sustainable Use of the Danube River.

Bosnia and Herzegovina is a member of the International Commission for the Protection of the Danube River (ICPDR) and the International Sava River Basin Commission (ISRBC).

The ISRBC is a joint body with the international legal capacity necessary for the performance of its functions, i.e. the implementation of the Framework Agreement, and for the realization of jointly agreed goals: establishing an international navigation regime on the Sava River and its navigable waterways, establishing sustainable water management and undertaking measures for communication, limiting hazards as well as eliminating harmful consequences caused by floods, ice, droughts, and accidents involving materials hazardous to water. The seat of the Sava Commission is in Zagreb, Republic of Croatia.

Data-sharing is done through online access and direct transmission. The largest part of the exchanged data is financed from sources from the state budget. Decision makers recognize exchange of information and data as one of the main open questions that needs to be upgraded.

From the perspective of Bosnia and Herzegovina, the sharing of data and information has the potential to be a great achievement as countries have begun to cooperate within the region. Establishing personal relationships, building team spirit and international exposure of the regional cooperation could be fundamental achievements. Some information and data could reverse current and future degradation trends through improving scientific understanding of the shared water. Countries from the region should develop a platform on which they could develop a network of systematic monitoring of the quality and quantity of water and adopt measures in this regard. Then countries in the region could achieve the following types of outcomes:

- Increasing stakeholder involvement and awareness building,
- creating knowledge and improving communication,
- improving access to finance,
- improving governance,
- building adaptive management, and/or
- construction of physical capacity/infrastructure (including green infrastructure).

Source: Case study by Biljana Rajić, Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina, 2022

Lesson 40. Improve awareness and strengthen transboundary cooperation through data and information sharing.

Shared data and information help to develop a common language between the riparian countries and allow reaching of a broader public, including academia, users, and the press, among others. This enables the public to become aware of the situation in every part of the international basin and to better understand the water resources. It also helps to consolidate entities and international support and increase public awareness and stakeholder participation.

Sharing of data and information and thus co-creating knowledge helps in building trust by establishing personal relationships and building team spirit. It has positive impacts at the environmental level, but also at the diplomatic level. Regular sharing of experiences, knowledge, methods, approaches and practices, proof-based bilateral coordination of transboundary protection of groundwater resources, access to the data beyond national borders, etc., supports professional growth of experts and provides a greater understanding of the challenges to help make better decisions for the development of transboundary river basins. It can strengthen the coordinating role of the RBO or other joint body, especially in joining efforts and looking for synergies based on common objectives.

[73] Decision on ratification of the agreement, Official Gazette of Bosnia and Herzegovina, number 10/15

Case study 59. Developing transboundary water quality monitoring of the Teno River

Lessons learned covered in this case study: Lesson 4, Lesson 11, Lesson 40

Finland and Norway signed the Agreement concerning the Finnish-Norwegian Transboundary Water Commission in 1980. The purpose of the agreement is to "preserve the unique natural conditions of the transboundary water bodies and their surroundings, and to secure the interests of both parties to the agreement, and especially the residents of the border region, in matters concerning the use of transboundary water bodies".

To implement the agreement, the Parties appointed a joint transboundary water commission, which acts as a joint cooperation and liaison body of the contracting parties in matters concerning transboundary water bodies. According to the agreement, the government of each Party appoints three members and one or more deputy members to the commission, with one member required to have experience in state water authority and one member required to have experience in the conditions of the border region. In practice the third member has been appointed as a representative of the local indigenous population (Sámi).

The agreement defines the water areas to which the agreement applies as well as the matters on which the commission can make proposals, statements and initiatives. According to the agreement, the role of the commission is to provide advice and promote cooperation. It does not have actual decision-making power regarding transboundary waters.

In the second meeting of the commission, it was decided that Finnish and Norwegian regional authorities would appoint an expert working group to prepare a joint water quality monitoring and reporting program for the Teno River, which is an important spawning river for Atlantic salmon shared by the two countries. The program was approved in 1987 with physical-chemical monitoring of water quality agreed to start in 1988 and biological monitoring in 1989. The first loading and water quality report was completed in 1990, resulting in the identification of a significant impact from domestic wastewater from the Norwegian side. The Norwegian government complied with the Commission's recommendation by constructing water treatment plans.

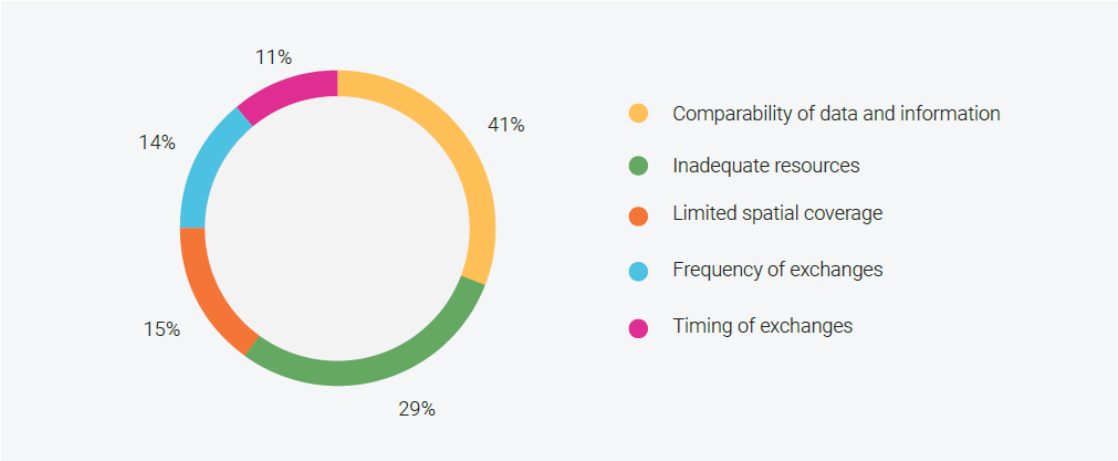
The program was implemented jointly by the two countries, with the Norwegian side in charge of collecting water samples, and the Finnish side analyzing them. The processing and reporting of the results was carried out in Norway. In this way, the costs from the monitoring program were distributed practically equally. This method of monitoring, based on mutual trust, was unique in transboundary water cooperation at the time. The methodology strengthened cooperation between participating authorities reflecting positively in the work of the Commission. After Finland joining the European Union, the monitoring of Teno River was further developed to meet the requirements of the Water Framework Directive and the Flood Directive.

Source: Case study provided by Kari Kinnunen, Water Convention Implementation Committee, 2023

9. Main difficulties and challenges

In the second reporting exercise under the SDG indicator 6.5.2 and under the Water Convention (2020-2021), countries highlighted comparability of data and information (41%) and inadequate resources (29%) among key difficulties and challenges of data and information sharing (see Figure below). The lessons learned in this chapter focus on overcoming the challenges in data and information sharing.

Figure: SDG indicator 6.5.2 reporting template, section II, question 6(g) – What are the main difficulties and challenges to data exchange?



Source: UN-Water, UNECE, UNESCO. Progress report on SDG indicator 6.5.2, 2021.

Lesson 41. Ensure sufficient resources for data and information sharing.

In transboundary cooperation, resources are often limited, limiting the level of cooperation. Funding is a limitation that is often mentioned, e.g., limiting the number of and maintenance of monitoring stations but also limiting possibilities for face-to-face meetings and training. Also, human resources are often insufficiently available. Therefore, resources should be sought to ensure long-term monitoring and data and information sharing.

As groundwater systems are often complex environments, they require expensive and long-term efforts. In most groundwater systems, the system must first be assessed and understood sufficiently, e.g., identify the location and the volume of groundwater, the flow direction and rates (which may vary at depth and over time). This requires a 3-D approach. When an aquifer has been reasonably assessed, the interpretation of groundwater monitoring data still requires continuous efforts, again due to the complexity of groundwater systems. Substantial resources are therefore required for proper groundwater monitoring.

Case study 60. Limited resources for the Ramotswa Aquifer

Lessons learned covered in this case study: Lesson 5, Lesson 7, Lesson 11, Lesson 12, Lesson 17, Lesson 19, Lesson 28, Lesson 31, Lesson 32, Lesson 39, Lesson 42

The Ramotswa transboundary aquifer is shared between Botswana and South Africa. The institutions responsible for groundwater data collection and sharing are the Botswana Department of Water and Sanitation (DWS), the Water Utilities Corporation (WUC) in Botswana and the South Africa Department of Water and Sanitation. The Department of Water and Sanitation of Botswana shares groundwater data upon request. The groundwater data collected by the Department of Water and Sanitation of South Africa are available for free online in the National Groundwater Archive.[74]

There is no regular exchange of data between the two countries. The exchange of data has been on a case-by-case basis, as part of groundwater assessment and capacity-building projects. Data have been collected, harmonized, and made available in the Ramotswa Information Management System (RIMS), [75] which is hosted by the SADC Groundwater Information Portal (GIP). [76] This took place between 2015 and 2019, during a USAID-funded and IWMI-led project. [77] The datasets supported the first joint assessment of the Ramotswa Aquifer and the groundwater resources as well as the environmental, socioeconomic,

[74] https://www.dws.gov.za/NGANet/Security/WebLoginForm.aspx

[75] https://sadc-gip.org/maps/305

[76] https://sadc-gip.org/

[77] https://www.iwmi.cgiar.org/success-stories/striving-for-a-groundwater-secure-future-in-the-limpopo/

legal, institutional, and livelihood contexts of the Ramotswa area. [78] Since 2019, the RIMS remains available online but there has been no collection of additional data. In the Joint Strategic Action Plan (JSAP) of 2020, [79] the two countries have committed to share data, and even to engage in joint groundwater monitoring activities.

The two countries meet a few times per year to address groundwater issues specifically, as part of the Limpopo Groundwater Committee (LGC). The LGC is a recent structure of the Limpopo Watercourse Commission (LIMCOM), working as an advisory body for groundwater matters and transboundary aquifers in particular. The LGC comprises country representatives from the four LIMCOM member states, among which Botswana and South Africa. LGC meetings are an opportunity for the countries to exchange on transboundary groundwater, including the Ramotswa Aquifer (located within the Limpopo Basin), but there is no exchange of data and no updated assessment of groundwater resources in the Ramotswa and the rest of the Limpopo basin.

There is no financial commitment between the two countries and advances in transboundary cooperation are highly dependent on external donors through funded projects (e.g., RAMOTSWA phase I, RAMOTSWA phase II, Big Data and Transboundary Water Collaboration).

The two countries have the necessary conditions for effective transboundary data-sharing:

- Groundwater data is available.
- Data can be shared. In the case of South Africa, data is even open.
- There is already a platform (RIMS) to support the exchange of data.
- The two countries are in good terms and have been collaborating on the Ramotswa Aquifer for many years.
- The two countries have committed to share data, in the Ramotswa JSAP and through the LGC.
- There is a good reason for investing in joint groundwater management, as the surface reservoir supplying the city of Gaborone is depleting. The Ramotswa Aquifer is currently the only alternative source of water in the area, while the aquifer in places is under threat from nitrate pollution. [80]

The absence of transboundary data exchange and assessment can be explained as currently, neither the LGC nor LIMCOM have enough capacity to fulfil this role. The LGC is a group of experts meeting twice per year. LIMCOM has a few staff, no website, no hydrogeologist, no capacity to undertake significant activities or to support the sharing of water data among riparian states.

The Joint Strategic Action Plan of 2020 is a positive development to capitalize upon in creating stronger political commitment to regularly exchange data and information on the Ramotswa aquifer, along with developing the necessary human, technical and financial capacities.

Source: Case study provided by Arnaud Sterckx, International Groundwater Resources Assessment Centre (IGRAC), 2022 and Karen Villholth, Water Cycle Innovation based on reports by the Botswana Department of Water and Sanitation

Lesson 42. Build trust to enable data and information sharing.

When there is mistrust between riparian countries because of political rivalries and conflicts or political instability, sharing of data and information is difficult. Some countries do not have an open data policy or data and information is considered sensitive. Trust building is in those situations essential to enable data and information sharing. Among others, Lesson 3, Lesson 5, Lesson 20, Lesson 30, and Lesson 40 show possibilities for trust building through data-sharing.

[78] https://drive.google.com/file/d/0B-Ajpddeja2ITWtkUGdvTmpNRmc/view?resourcekey=0-mBDLU7Mzr3192ez-bQ4uMQ

[79] http://conjunctivecooperation.iwmi.org/wp-content/uploads/sites/38/2020/02/Ramotswa-JSAP_-May-2019-.pdf

[80] http://conjunctivecooperation.iwmi.org/wp-content/uploads/sites/38/2019/05/Ramotswa-project-brief-Nitrates-and-Climate-change.pdf

Case study 61. Trust building through cooperation in the North-Western Sahara Aquifer System (NWSAS)

Lessons learned covered in this case study: Lesson 2, Lesson 19, Lesson 27, Lesson 31, Lesson 40, Lesson 42

The North-Western Sahara Aquifer System, which contains mostly non-renewable groundwater, is shared between the three countries Algeria, Libya, and Tunisia. The respective national institutions responsible for monitoring and data-sharing are:

- National Agency for Hydraulic Resources of Algeria (ANRH)
- General Water Resources Authority of the Ministry of Water Resources of Libya (GWA)
- General Directorate of Water Resources of Tunisia (DGRE)

In 2007, the three countries set up the NWSAS Consultation Mechanism (CM) - a joint body, which is tasked with coordinating, promoting, and facilitating the rational management of the NWSAS water resources, including data and information exchange. The institutions forming part of the CM are the following:

- The Ministerial Council comprising ministers in charge of water resources in the three countries
- The Permanent Technical Committee (ANRH, GWA, and DGRE)
- The Coordination Unit
- Ad hoc working groups
- The national committees

The Coordination Unit is temporarily hosted at the headquarters of the Sahara and Sahel Observatory (OSS) in Tunisia. The Coordinator of the Coordination Unit is appointed by his/her country of origin for a two-year mandate based on an alphabetical rota between the three countries. This rota was launched in 2008 with Tunisia. A declaration was signed by the Ministers in 2006 mandating the countries to the conjunctive management of the water resources, including data exchange between the responsible institutions of the riparian countries. In addition, an Agreement Protocol has been established, which stipulates that the use of water resources in the NWSAS should consider the principle of cooperation, according to which it is necessary to develop relations between States, aquifer and basin organizations and regional organizations, with a view to ensuring integrated, concerted and peaceful management of water resources and the environment of aquifers and basins. The CM is presently coordinated and fully financed by the countries, which contribute yearly to its functioning. This allows data and information exchange, the updating of the database and the modelling and visualization tools, and the implementation of capacity building activities.

The types of data and information exchanged are mainly related to hydrogeology, hydrology, socioeconomics, and climate change. They also include metadata, mostly related to remote sensing.

Information exchange mainly refers to:

m) Monitoring data on the environmental conditions of transboundary waters: Water abstraction, water levels, and water quality
n) Information on best available technology: Exchange of experience and best practices
o) Results of relevant research and development: recharge and climate change impact studies, estimation of water abstraction using remote sensing, etc.
p) Emissions and wastewater: installation of water drainage systems
q) Measures taken and planned: recommendations for better management of water resources
r) Permits or regulations for wastewater: water quality assessment

The gathered data is processed and integrated/stored into a joint database called “SAGESSE” (Système d'Aide à la Gestion des Eaux du Sahara SEptentrional) hosted at OSS, which is also installed at the national focal directorates in charge of water resources management of the ministries in charge of water resources. It is not open to the general public, but accessible by the national users working in or with the ministries. The data/outputs and information resulting from the data processing are findable, accessible, interoperable and reusable to the general public and decision makers.

More than 17,000 boreholes are recorded in the database. Monitoring data for subsets of the boreholes are transmitted on an annual basis from the national institutions in charge of water resources

management. The data supplied to update the database mainly concern water levels, water withdrawals, salinity (TDS) and, to a lesser extent, the results of chemical analyses. An integrated database-GIS-model was created to allow elaboration of thematic maps (such as water levels, piezometry, water abstraction, water quality/salinity) and water abstraction scenarios. In addition, several maps from applied remote sensing are elaborated and available in the database. Uniform geographical references and data units have been adopted and agreed across the countries to ensure the compatibility, comparability, and quality of the data (metadata, data dictionary, etc.).

The results of the monitoring and studies are published in joint reports. An annual report on the status of the database and update of the model simulations is shared with the countries. The countries use the model for their national investigations and project development planning.

In addition, an annual activity report is shared with the decision makers (the national directors of water resources) to inform them on the status of the shared aquifer resources. These reports are validated during an annual technical committee meeting, which formulates recommendations for the better management of the NWSAS.

The CM organizes awareness and capacity building training sessions (national and regional). The information related to the activities is published on its webpage, accessible to the public. [81]

The publication and exchange of data and information (such as conclusions from the simulation model) raises awareness among stakeholders to enhance the protection of water resources against over-abstraction and quality degradation and improve the livelihood of populations by ensuring the maintenance of their means of subsistence and facilitate the cooperation between the countries.

Countries meet regularly to discuss the best conditions for perpetuating the CM structure and making the best use of the strategic NWSAS resource. The main challenge encountered in exchanging data and information at the outset of the initiative was the establishment of trust between the countries. With the evolving confidence building, the countries exchange data and information more easily. A delay in annual financial contributions from the three countries to the operating budget of the CM remains a concern.

Source: Case study provided by Karen Villholth, Water Cycle Innovation based on reports by the Sahara and Sahel Observatory (OSS), 2023

Lesson 43. Reduce differences between countries to enable sharing of data and information.

Differences in level of knowledge between riparian countries can hinder sharing of data and information. Training is not always possible, hindering the cooperation. Moreover, different countries use different systems and harmonization is difficult while the quality of the data may be insufficient. The data is often fragmented with different agencies and it may be difficult to obtain all the relevant data. A process is needed to reduce such differences, with the aim of enabling sharing of data and information.

Case study 62. Main challenges for strengthening data-sharing at regional level in Central Asia

Lessons learned covered in this case study: Lesson 13, Lesson 43

The International Water Assessment Centre (IWAC), in cooperation with the Water Convention secretariat and GIZ Green Central Asia Programme, organized a regional workshop on monitoring, assessment and information sharing in transboundary basins in Central Asia in February 2023. The workshop aimed at facilitating the sharing of experience in the field of monitoring water resources and improving cooperation between five countries in the region (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan) on the protection and use of water resources.

Workshop participants noted the positive trend in data-sharing in the region and identified many good examples of cooperation on monitoring and data-sharing, including the Chu-Talas Water Management Commission (Kazakhstan-Kyrgyzstan) (see Case study 37), water quality monitoring in the Syr Darya River basin (Kazakhstan-Uzbekistan) (see Case study 26), hydrological data-sharing between national

[81] http://www.oss-online.org/en/nwsas-cm

hydrometeorological authorities (see Case study 35), and cooperation, assessment and modelling in the Pretashkent transboundary aquifer (Kazakhstan-Uzbekistan) (see Case study 49).

However, participants noted that several challenges for monitoring and assessment of water resources in the region do not receive sufficient attention. The workshop highlighted the need for joint efforts to harmonize data collection, strengthen monitoring and data-sharing on water quality, develop early warning systems on water pollution at transboundary waters and improve the collection and sharing of data on transboundary aquifers. Specific challenges noted by participants were insufficient funding and lack of proper equipment limiting monitoring and data-sharing, need for more interactions on hydrological forecasting and development, lack of access to information and data on water resources, limited focus on consolidating efforts to combat climate change effects, lack of agreements on groundwater and the need for joint bodies to coordinate monitoring and assessment.

Participants emphasized the need for a phased approach to developing interactions between the countries on data-sharing in transboundary basins based on existing national monitoring systems, harmonization of methodology and standards for data collection, development of a regional observation network and the development of institutional mechanisms for regular data-sharing in transboundary basins. The workshop outcomes highlighted the importance of developing bilateral and regional agreements regarding cooperation on monitoring and assessment of water resources including specific mechanisms for joint monitoring and regular data-sharing.

Source: Case study provided by Zhanar Mautanova, based on the Outcomes from the Regional Workshop on Monitoring, Assessment and Information Sharing in Transboundary Basins in Central Asia, 2023

Further reading

UNECE, 2021. Funding and financing of transboundary water cooperation and basin development. https://unece.org/environment-policy/water/areas-work-convention/financing-transboundary-water-cooperation