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SWP Study visit on River Basin Management

Report, November 2017

SWISS WATER PARTNERSHIP

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Background and Rationale

The Government of Tajikistan (GoT) is very active at international and national level in addressing water management. Following the initiative of GoT, the UN adopted recently the resolution on the next decade of Water for Sustainable Development. At the national level the GoT has been making efforts in reforming its water sector in line with the Water Sector Reform Programme adopted on December 30th, 2015. The main principle of the reform is moving the water management from administrative boundaries to hydrological basins, and this significant change will require setting up the river basin management institutions (River Basin Organizations and River Basin Councils) in line with IWRM principle. The knowledge on the river basin management theory and international experience already exists at the national level but not yet at the basin level, where the reform is to be implemented.

The Study Visit on River Basin Management and their Institutions, theory and international practice, is organized for Syrdarya Basin and Zervshan Sub-Basin water reform leaders to build their common understanding on the reform principles: specifically, IWRM and river basin management. The Study Visit is organized jointly by the SDC funded NWRM Project implemented in Tajikistan Syrdarya Basin and the EU funded Rural Development Project implemented in Zeravshan Sub-Basin. The representatives of Syrdarya Basin and Zeravshan Sub-Basin water stakeholders, the foreseen future basin reform leaders, have visited Switzerland to learn about the theory and the international lessons learnt on the river basin management, and afterwards Spain to learn about the practical

application of the river basin management and IWRM principles. The Swiss Water Partnership (SWP) was mandated to support the organisation of the Study Visit in Switzerland.

Objectives of the Study Tour

The overall objective of the Study Visit is to build the common understanding of the future Syrdarya Basin and Zeravshan Sub-Basin water reform leaders as the basis for cooperation with the SDC funded NWRM Project and the EU funded Zeravshan Project on implementing the Water Sector Reform.

The specific objectives of the Study Visit are the following:

- The participants of the Study Visit have the same understating of the river basin management and its institutions, including the main principles, especially the basin management and IWRM;
- The participants have a knowledge on the basic theory and the international lessons learnt on the river basin management and the basin institutions;
- The participants strengthen their partnership and extend their network with Swiss based organisations and resource persons as basis for potential longer term partnerships;
- The participants learned the practical application of the river basin management and the basin institutions and are able to draw lessons learnt for the water reform in Tajikistan Syrdarya Basin and Zeravshan Sub-basin.

Program and Documentation

Agenda Day 1

Time	Agenda Item	Presenter
09:00-09:10	SWP Welcome Note + Introduction Round	Soraya Kohler, All
09:10-09:40	Introduction on IWRM	Christian Bréthaut
09:40-10:00	MoEWR Video	Delegation MoEWR
10:00-10:15	Coffee Break	
10:15-11:00	Specific focus on IWRM: Historical Perspective, Strengths and Weaknesses	Christian Bréthaut
11:00-11:15	Short Break	
11:15-12:00	The GOUVRHONE Project (Case Study): The Rhône River Basin and Different Types of Management Regimes	Christian Bréthaut
12:00-14:00	Networking Lunch + Market Place	SWP Members, Delegation
14:00-15:00	Moving Towards Integrated Water Resource Management at the Local Level, the Case of the Canton of Geneva (Focus: Ground Water)	Gabriel de Los Cobos
15:00-16:00	Transboundary Collaboration and River Renaturation Concepts with Concrete Examples from Projects (Focus: Surface Water)	Sepideh Nayemi
16:00-16:15	Coffee Break	
16:15-17:30	Discussion	All

Agenda Day 2

Time	Agenda Item	Presenter
09:00-09:10	Welcome Note & Agenda	Mara Tignino (GWH / UNIGE), SKO
09:10-09:40	Introduction to the UNECE Water Convention: Key Principles	Mara Tignino (GWH / UNIGE)
09:45-10:15	GWH introduction from François Muenger, Director of the Geneva Water Hub, Secretariat of the Global High Level Panel of Water and Peace	François Münger (GWH / UNIGE)
10:15-11:00	Mechanisms to Conciliate Conflicting Water Uses: The Case of Crans-Montana - Challenges to Implement IWRM at Local Level	Emmanuel Reynard (Prof. UNIL)
11:00-11:15	Coffee Break	Catering WMO Cafeteria
11:15-11:45	State of Discussions between France and Switzerland on the Rhône River	Sibylle Vermont (FOEN)
11:45-12:15	SDC Blue Peace Initiative & Discussion	Stephanie Piers de Ravenschoot
12:30-13:30	Lunch	Cafeteria WMO, 6th floor
13:45-14:15	Implementation of the UNECE Water Convention	Batyr Hajiyev (UNECE)
14:30-15:15	Case Study on the Senegal River Basin	Komlan Sangbana (GWH / UNIGE)
15:15-15:30	Final Remarks, Feedback	Delegation
16:00-17:00	Guided Tour UN Geneva	Delegation

Agenda Day 3

Time	Agenda Item	Presenter
09:00-11:00	Transfer to Aare Port	
11:00-11:15	Coffee Break at Restaurant Romantica	
11:30-12:30	A Historic Perspective on Conciliating Water Uses: The Corrections of the Jura Lake and Rivers Systems	Hanspeter Früh
12:30-13:30	Visit of the Lake Regulation and Other Facilities at Aare Port	Hanspeter Früh
13:45-14:30	Introduction to the Swiss Flood Protection Strategy	Carlo Scapozza
14:30-14:45	Lunch Bag and go to Bus	
14:45-17:15	Transfer to ZRH Airport	

Summary of Discussions Day 1 & 2

I- Discussing Concepts and Definition

First part of the study tour aimed at giving keys to understand a complex and evolving sector and open the debate on concepts and definitions.

Governance and Water Governance

- ✓ Governance has become quite a popular notion, with different meanings and uses of the concept, often described as good or bad with the notion of good and bad being "fuzzy".
- ✓ Most usually governance highlights a process that includes different types of stakeholders (it differs from the government because it includes non-governmental actors) and as it is a process, it is not stable; it evolves along with successes and failures (kind of journey).
- ✓ The difference between governance and management is that management is a more operational concept (e.g. how to ensure water delivery in quantity and quality) whereas governance is an overarching concept (how to drive a policy, how to make sure all stakeholders are on board etc.).
- ✓ Since two decades, water governance has generated a growing attention: the nature of water (i.e. its difficulties of exclusion and subtractibility) and the impacts of climate change raised concerns that water systems/services were not equipped or able to adapt and the triggering factor was governance failures.
- ✓ More and more the water crisis is perceived as a governance crisis.
- ✓ Most usually the definition of water governance involves multiple stakeholders, the need to consider bottom-up dynamics along with top-down approaches, the fact that it is a decision-making process that has to adjust according to the effects of policies and uses in practices.
- ✓ The evolution of the water sector shows that growing environmental concerns and climate change impacts has led to a paradigm shift: i.e. water not only being perceived as a hydrological issue but also taking into account social and economic issues: "water as a social-ecological system".
- ✓ This shift is challenging because of the nature of the resource (water being already under pressure) and the specificities of the sector (inertia, interdependencies, capital costs versus long term benefits).
- ✓ Different champions have emerged with itch its ways how water should be managed, its political agenda (IWRM, nexus, transboundary etc.): these normative concepts have a huge impact on the sector and on its funding. All aim to advance solutions in practice but entail weaknesses (i.e. they are well defined in theory but do they fit to reality, measurement difficulties, lack of concrete guidelines).

Integrated Water Resources Management (IWRM)

- ✓ The most common definition is the one popularized by the Global Water Partnership (2000), including the principles of coordinated management (water as an entry point to other resources), the need of an inter sectoral approach (water transversal resource and entry point to different sectors), the consideration of economics (in line with other framework such as sustainable development), actors' participation and basin as a relevant scale (this last principle being added in 2009).
- ✓ The definition is very broad leading to implementation difficulties but allowing tailored adaptations to specific situations.
- ✓ For GWP, the historical perspective shows an evolution towards integration; the future being the multi levels comprehensive governance.
- ✓ IWRM is a framework with many added values: among others it is a step towards stronger inclusion, it implies the coordination between different uses, it shows the importance of the legal and policy frameworks at different levels.
- ✓ However IWRM has also lead to criticism:
    - Management scale (is the basin always the relevant unit? E.g. in Switzerland all institutions used the framework but a few applied the hydrological scale. What about transboundary scale?);
    - Implementation gap between theory and practices: such as challenges to coordinate different sectors with different political agenda and economic pressures although competition among sectors can also bring solutions;

II- IWRM at Local Level: Geneva and Cran Montana Case Studies

IWRM at Local Level: Case Study Geneva Aquifer

A few facts about this aquifer: it is a transboundary aquifer of 30km^2, formed on fluvial glacial deposits and exploited by both Switzerland (10 wells) and France (5 wells) for drinking water purposes. It is naturally recharged by the Arve River (tributary of the Rhone River). Between 1960 and 1980, the aquifer was overdrafted with withdrawal rates up to 14 Mm^3/year. This overpumping lowered the groundwater level by more than7 m in 20 years.

Artificial Recharge: A cost-effective solution to lower the pressure on the aquifer
To face this problem, there were 2 options: i) either to reduce the pumping of the aquifer (i.e. meaning looking for an alternative solution for drinking water: building a new pumping and treatments plant on the Geneva lake) or ii) to reinforce the natural capacity by artificial recharge. To make the decision, two criteria were screened: water supply security (diversification of sources) and economic criteria (costs comparison between the construction of a new plant and the setup of the artificial recharge system). The artificial recharge system was proven to be cost-effective and performant as in more than 35 years of exploitation, the artificial recharge system of Geneva brought over 300 Mm^3 of treated water into the "Genevese aquifer", i.e. 7-10Mm^3 per year.

Administrative and political aspects

- ✓ From 1972 to 1977, experts from both sides worked on drinking water resources and hydrogeological issues (technical studies to assess losses, natural recharge, futur pumping and fees) in order to laying the bases of a future Franco-Swiss agreement.
- ✓ The red thread was to establish equitable cost sharing, i.e. with the cost of artificial recharge (depreciation, interest, usage and renovation costs) spread among all groundwater users, whatever the origin of the water (natural or artificial recharge).
- ✓ A first agreement was signed in 1978 for 30 years between the canton of Geneva (Switzerland) and the department of Haute Savoie (France):
    - o It ignores territorial sovereignty and territorial integrity concepts and follows a pragmatic approach based on a rational management of the common resource.
    - o It covers the overall management (commission), the operation of the artificial recharge system, water rights and water pricing.
- ✓ It was renewed in 2008 for 30 years and embedded in legal instruments (general instruments like the Karlsruhe agreement and specific ones for water protection)

Benefits, success factors and challenges

- ✓ Direct benefits:
    - o It is possible to manage a transboundary aquifer with direct proven benefits (15 million m3 stored);
    - o It allows a seasonal management of water (artificial recharge is done in spring) and has nearly no impact on the Rhone as less than 2% of the Arve River is taken and infiltrated.
- ✓ Success factors:
    - o To tackle a problem relating to international water resources at local level, rather than at the level of sovereign states, with technical aspects well known and dealt with by local actors who would then relay the information to decision-makers at the local level.
    - o Guidelines were useful to setup the system: referring to technical ones from the Swiss Hydrological Society or governance ones e.g. UN International Law Commission.
    - o The joint Commission is absolute key, i.e. i) to elaborate and monitor implementation of a plan for drinking water distribution for the whole region, ii) to have a common understanding of the risks, iii) to increase groundwater protection regarding possible upstream pollutants and iv) for a harmonized communication to the public.

- ✓ Challenges:

- Differences in technical standards and administrative management are challenges that have to be dealt with.
- Geological and hydrological data gap between France and Swiss parts of the aquifer is also a challenge.

IWRM at local level: Geneva rivers renaturation program

A few facts about Geneva Rivers: 337km or rivers and streams, transboundary watersheds between France and Switzerland. There is no water shortage but the water management is complex as the population density is high (1870 persons/km²) and expectations of the population are high (quality life and environmental issues). Therefore the challenge for the Geneva canton is to maintain and enhance natural resources and biodiversity despite growing urbanization, industrialization and population. The solution the canton has applied is embedded in the IWRM framework with 3 pillars: river renaturation, transboundary agreements and communication & public awareness.

Triger point for a change in mind set
Despite heavy investments on wastewater utilities and 95% of connexion rate, the river quality is poor and not improving. River morphology was damaged; e.g. the river Aire is typical: all meanders have been removed and in the city the river is buried. This led to the following problems: polluted water, fishing was prohibited, river bed disturbed, still floods when heavy rains etc. To tackle this issue, the Canton adopted in 1997 a renaturation program "to protect and renature the rivers and their landscape promoting biodiversity of these elements in the perspective of Sustainable Development". A cantonal renaturation fund was created with funding from taxes from the hydroelectric plants using the Rhone water, taxes from pumping authorisations, canton and Confederation subventions. Communication is key to facilitate this change in mind set, especially towards people living next to the river, farmers and other users; with the issue of flood and possible material damages and possible loss of human, acceptance is higher than for "just" a greater biodiversity. In practice, there are several options to remove a river from a canal: either you let the river makes its own way and build its new natural bed or you help the river and provide better habitats for the bed (e.g. "chocolate bar" design).

Transboundary issues
The French State, the Geneva Canton and the French local authorities agreed in 1997 to sign a transboundary protocol (under the Karlsruhe agreement) with the following objectives: i) sanitation and water quality, ii) protection of residential areas from flooding and iii) ecological and landscape quality of rivers and wetland. Concretely a transboundary river agreement is a technical and financial agreement covering the entire watershed, with an action plan involving French and Swiss funding, for duration from 5 to 7 years. Again these river agreements require a lot of communication and the involvement of all stakeholders. However this challenge is much easier to deal with at local level than it would be to tackle it at national level.

Challenge to implement IWRM at local level: case study Crans Montana

A few facts about the study area: there are 4 watersheds in the area, different land uses according to the elevation, 11 communes crossing the boundaries of the watersheds and one tourist resort crossing both political and hydrological boundaries. The fact that there are no coincidences between the environment limits, the political limits and the economic limits makes water management quite complex. Hydrologically, the gradient of precipitation is high: from 500mm/year in the valley to 2500mm/year in the upper part, i.e. water is not abundant were people live and use water.

Water resources features and water uses
There are three main sources of water: snow, glacier and springs and two main features: i) an inter-monthly variability of the resource (little water in winter and a lot in summer) and ii) a big variability between dry and wet years (water volume being divided by two in dry years). In addition climate change will impact paradoxically with more water in the next decades and then availability will decrease over the period 2060-2090. Regarding water

uses, about half of the water is used for hydropower while other uses represent roughly 10-12% (the rest being unused). The main characteristic of the demand is that it is seasonal, the peak being in July & August.

Water uses challenges

- ✓ The complexity of the water management: also the area is rather small the management of water is complex due to the following factors (Reynard ppt, slide 39):
  - Some communes are linked for water management with informal agreements (e.g. Icogne, Montana, Lens and Chermignon), others manage water solely (e.g. St Léonard);
  - Some communes have a lot of springs on their territory (e.g. Randogne), others have to bring water from springs located outside their territory (e.g. Montana);
  - In addition to public property on springs, some springs are in private property and other are under a concession regime (mainly for hydropower uses).
- ✓ Adaptation to climate change, two scenarios are discussed: with or without regional adaptation measures:
  - The impact of the decrease of rain in summer and the melting glacier will result in water scarcity especially in the 2nd part of the summer;
  - To balance the water shortage, an adaptation measure could be to store water in spring and early summer and use it in the 2nd part of summer and winter.
  - But operating these multipurpose reservoirs present challenges such as the energy challenge (changing energy market, energy transition, concession renewal)-

As a conclusion:

- It appeared that it was not possible to apply "pure" IWRM in the case of Crans Montana (and mainly in Switzerland) due to the commune's autonomy and the complexity of water rights and water management;
- Hybrid solutions have to be developed to solve coordination issues between different water users, i.e. technical solutions (multipurpose reservoirs and water transfers) as well as institutional ones;
- The concept of water use cycle may be useful along the basin concept and the hydrological regime: using these 3 concepts on the demand side instead on focusing on the resource allows taking into account the seasonality of the demand and managing water accordingly.

III- Governance of International Watercourses

Governance of the Rhone River

A few facts on the Rhone: no international commission for its management (although a commission has been set for the Geneva lake), a river long considered for its productive use (mainly hydropower), only a few actors involved in its management (e.g. only two hydropower companies), growing tensions between France and Switzerland about the management of the lake levels, specific hydropower operations (e.g. sedimentation flushing with downstream impacts) and the coordination issue and growing concerns about environmental issues.

Governance systems: difference between Switzerland and France

- ✓ Swiss side, mainly under public law: level of the lake managed by three Cantons (intercantonal agreement), hydropower operator free to apply its own energy strategy as long it respects the levels of the lake defined by the agreement, Canton Geneva having a key role as link to the French authorities and partially owner of the hydropower operator;
- ✓ French side, mainly under private law: management model structured around self-organization of private actors, priority given to nuclear power production by the national state, local authorities not involved.

Strengths and weaknesses of the governance system

- ✓ The strengths of the system are the following: the strong regulatory capacities of the two countries, the flexibility and adaptative capacities due to the self-organization of the private stakeholders, including the reactivity in times of crisis.

- ✓ The weaknesses of the system are the following: strong institutional fragmentation (which means that it is not always clear which actor should act to solve an issue), lack of common vision of the river management, few discussion on quantitative issues (quality issues being taking into account by the lake commission), sectorial perspective as the governance has long been structured according to the hydropower sector.

Future transboundary governance of the Rhone River

Future governance should move towards integration of more actors and taking into account the environmental perspective. Different scenarios can be drafted:

- The *integrated model,* following the Rhine River Commission: the river basin scale is used as a relevant unit to manage the river. This model decreases the transaction costs and improve coordination however there is a challenge to integrate national management policies and it may impact the flexibility and adaptative capacities.
- The *monofunctional model*, e.g. the Danube River Commission: here, the idea is to focus on sectors of activities and reinforce coordination between sectors. This model allows having entry points to manage rivalry uses for better regulation; it is a step towards an intersectoral scale. However it also entails risks such as the neglecting of certain uses or the possible disconnection of public actors regarding management operations.
- The p*olycentric model*, e.g. The Rhone River nowadays: it is characterized by a strong complexity, with many decision arenas more or less coordinated. The strengths of this model relies on its flexibility, the innovative learning by doing approach building institutions towards solution-oriented approaches,

Future Transboundary governance of the Rhone River: work in progress

- First step: inventory of the organizations dealing with agreed priority topics;
- Institutional working group to propose a joint body and its attributions (UNECE convention), respecting the subsidiarity principle;
- Common understanding of the needs and challenges: i.e. towards more integration of the Rhone watershed, ability to cope with climate change impacts and to anticipate problems.
- Importance of f2f exchanges to build trust, fight preconceived ideas (e.g. upstream takes too much water) and misunderstandings (e.g. it is the same language however a century flood in France doesn't have the same definition than in Switzerland, "platform" has different meanings).

Governance of the Senegal River

A few facts on the Senegal River and its commission named "OMVS": the droughts in the 70's really triggered the beginning of the cooperation. The OMVS was created in 1972 with 3 out of 4 riparian countries, Senegal, Mauritania and Mali (Guinea joined in 2006) with the mandate to manage water efficiently in a water scarcity context, taking into account both environmental issues and economic development, including incomes of the local populations.

Progressive set up of the legal instruments:

- ✓ In 91972: the recognition of the international statute of the river allowed to create the OMVS management structure;
- ✓ In 1978, a specific convention established the legal status of joint infrastructures (such as dams or dykes);
- ✓ In 1982, with an additional convention the OMVS clarified the funding modalities of these infrastuctures;
- ✓ Finally in 2002, the Senegal River Water Charter includes the management of the different uses; it is the first transboundary instrument to take into account the human right to water and sanitation.

Focus on the Joint Infrastructures[1] Legal Regimes

[1] Shared infrastructures so far: Manantali Dam, Diama dam, the river-sea port of St. Louis, Kayes the river port and any ancillary facilities or annexs.

- ✓ A dam is a common property of riparian countries although it is constructed on the territory of one of them (that means it is exempt from requisition, confiscation and expropriation);
- ✓ OMVS member states act as co-guarantors for the repayment of any loans ;
- ✓ Contributions as co-guarantors are proportional to the country participation in the costs and expenses of such works in accordance with the allocation key.
- ✓ The allocation key is equitable: it is determined through the calculation of the share that each State is ready to support according to its interest and can be revised upon demand.

Institutional mechanism supporting the management

- ✓ Creation of public interstate agencies to manage the common infrastructures;
- ✓ A permanent water commission, a consultative organ for the OMVS council of Ministers to check the equitable and reasonable use of the Senegal river and the respect of the allocation key.

Lessons learnt from the OMVS case study:

- The development of joint infrastructures on international watercourses creates opportunities for cooperation between riparian States while supporting the continued development of river networks.
- Co-funding mechanism of joint infrastructures is an incentive for continuous cooperation between riparian States. It then contributes to prevent conflicts and maintain peace between States
- Equitable share of costs and benefices reduce tension between riparian States and diminished the risk of conflict.
- Co funding help to reduce the cost of unilateral action in planning the shared watercourses.
- A long term cooperation needs a strong legal framework.

The UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes

The Convention was adopted under the aegis of UNECE (United Nations Economic Commission for Europe) but the scope was larger as UN regional economic organisation are part of it (56 Member States including Central Asia, North America, Israel). In 2013, an amendment was made to open to all members States. The convention was completed by 2 protocols, one on water & health and the other on civil liability.

Scope of this legal instrument:

- ✓ It covers both surface water and groundwater that crosses two or more states (art 1);
- ✓ It focus not only on water courses but takes into account water basins;
- ✓ It covers both water and land;
- ✓ In addition other elements of the environment, such as air, fauna and flora, are as well taking into account.

Aim and principles

- ✓ The goal of the convention is to prevent transboundary impacts;
- ✓ It is guided by three principles:
    - The precautionary principle: even in case of scientific inaccuracy states have to take measures to prevent impacts;
    - The polluter pays principle: based on the fact that in case of contamination of water bodies, the polluter has to pay the costs of environmental damages in order to restore the ecosystem;
    - The sustainable development: i.e. the protection of the environment, the economic and social development should be read together and the rights of future generations have to be taken into account.

Obligations to riparian countries

- ✓ They shall put old agreements in harmony with the principles of the convention;
- ✓ In case no agreements pre-existed, they shall draft new ones with equality and reciprocity;
- ✓ They shall create joint institutional mechanism such as data sharing mechanisms or warning alarms procedures.

The institutional framework

- ✓ Most important is the Meeting of the Parties (MoP) every three years;
- ✓ The MoP can draft amendments, create working groups or taskforces.

As a conclusion:

- The UNECE Water Convention can strengthen the global governance of transboundary water resources: it is a reference framework for the negotiation of specific agreements (for instance the Convention on the Use of the Danube River in 1994 or the Convention on the Protection of the Rhine in 1999 have drawn on this convention);
- Importance of the institutional framework to adapt the UNECE Water Convention to the needs of the Parties.

IV- Towards a Blue Peace Central Asia

The Blue Peace concept is actually the concrete illustration of Switzerland's belief and commitment to foster transboundary cooperation on issues around water, for a water secure world.
It works along 2 levels of interaction:

- Governmental level : lead policy dialogue to engage the governments and responsible ministries in providing an enabling environment, both at national and regional level
- Technical professional's' level and people: bring this concept into action, by developing concrete projects on the ground, working on commonly defined challenges – which can range for introducing water accountability tools and techniques, to developing climate change adaptation measures, to working on transboundary sub-river basins to deal with the issue of water scarcity or water pollution.

Tajikistan is the water tower of Central Asia, as Switzerland is the one for Europe; it is an upstream country, concerned by climate change and disaster risk reduction. Switzerland offers an objective platform for dialogue on how to manage water in the region.

In Central Asia, the blue peace approach builds upon 3 main pillars:

- The diplomatic track: the approach is country-led (i.e. the countries decide what level of involvement they want) and has been structured around different conferences, with the Astana conference in 2017 being the most important one;
- The operational track: on the first meeting, the 5 countries agreed on specific priorities to be further explored with support from Switzerland (improvement and sharing of hydro data, climate change adaptation, water quality and joint infrastructures);
- The educational track: promoting a new generation, perhaps more open minded or that wants to explore solutions outside business as usual (i.e. building water networks, supporting young professionals).

Lessons Learned from the Field Visit

I- The Jurassic Water Correction and the Regulierwehr Port

The field visit allowed the experts from Tajikistan to gain an understanding about the regulation of a Swiss catchment area and learn more about the historic perspective of the corrections of the Jura Lake and its rivers systems.

The area of the Jurassic Water Correction (JWC) extends over 5 cantons of Switzerland (Waadt, Freiburg, Neuenburg, Bern, Solothurn) and contains 1/4th of all water in Switzerland.
The JWC consists of the following three main lakes in the region of Jura, Switzerland: Lake Biel, Lake Neuchatel and Lake Murten. **The JWC allows to regulate the lake water levels and the outflow conditions of the Aare river.** The decisions are based on a regulation that was accepted by the Swiss Federal Council. The discharge values need to be measured and controlled on a daily basis. Nowadays, the control of the different regulation systems is partially automatic, but it is monitored regularly through the main regulation office in Bern, which is hosted by the cantonal sewage treatment plant in Bern.
The weir "Regulierwehr Port" is the centrepiece of the JWC and is regulated by the head office in Bern. It was built between 1936-1939 and modernized in the 1990s with new machines, lock gates and a hydropower station (operated by the private company "Bielersee Kraftwerke AG"). The maintenance of the "Regulierwehr Port" is shared between different public and private stakeholders: 1) mainly the canton of Bern together with all the other cantons involved in the JWC and 2) the power plant company "Bielersee Kraftwerke AG". The navigation lock is fully maintained by the canton of Bern. There are regular routine checks and cyclic inspections and revisions at the weir and the lock.

The first Jurassic Water Correction

The first JWC (1868 – 1891) happened as follows: 1) redirection of the Aare river, 2) + 3) expansion and deepening of the rivers Zihl and Broye in order to lower and approximate the water levels in the three Jurassic lakes, 4) establishment of the canal called "Nidau-Büren-Kanal" that redirected the increased outflow back into the Aare river.

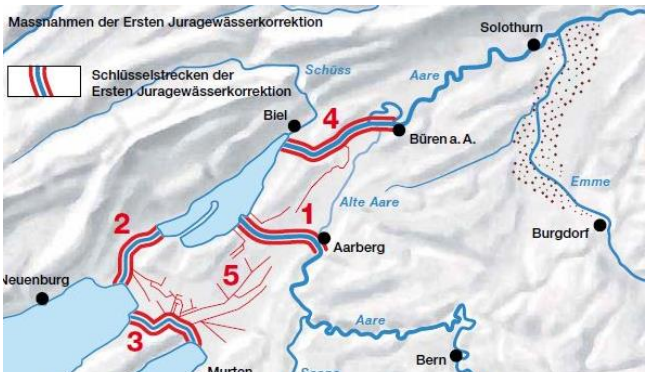

Figure 1 First JWC (1868-1891). Source: Hanspeter Früh.

Main results of the first JWC:

- Benefit: The diversion of the Aare and the adaptation of the water levels in the three Jurassic lakes transformed former marshland in productive agricultural Land and thus improved the living conditions in the Seeland region.
- Challenge: Although the danger of floods was reduced, it could not be eliminated and floods continued to occur. Further, during low water periods, the lake water level sank much deeper than desired. This resulted in slope slipping and collapsed shores that put on hold the shipping and the fisheries that requested an increase of the low water levels.
- This resulted in a replacement of the ineffective Nidauwehr at the outflow of lake Biel by the "Regulierwehr Port", a plant that was able to keep the water level at a certain minimal level and could ensure enough drainage capacity in the event of flooding.

Second Jurassic Water Correction

After two big floods in the 1940s and 1950s, the decision was taken to carry out a second JWC (1962-1973). The changes mainly consisted in widening and deepening the canals. Like the first JWC, the second was also financed by the government of Switzerland.

The results of the two JWC were the creation of one hydraulic unit consisting of the three Jurassic lakes and a reduced fluctuation rate and a higher outflow capacity from the lake of Biel.

Regulation

Since the 1980s, regulatory provisions have been established in order to delimit the average fluctuation range of the water levels of lake Biel (picture below).

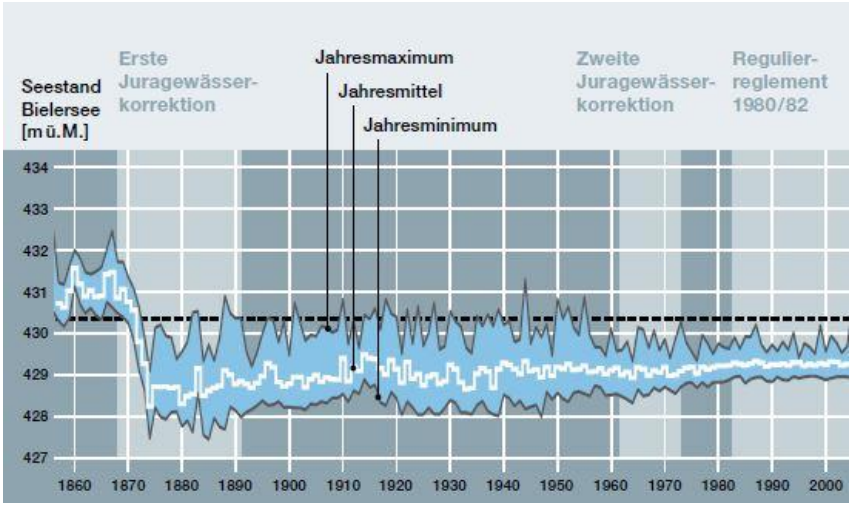

Figure 2 Average fluctuation range of the water levels of lake Biel. Source: Hanspeter Früh

Additionally, in 2008, a prognosis regulation mechanism was established that allows to anticipate flooding. With this tool, the Federal Department of Environment can calculate a 5-day meteorological prognosis for the entire catchment area of the JWC on which decisions can be made accordingly.

Challenges and Lessons Learned

- **Setting the ideal discharge values:** When determining the optimum water level in Jurassic lakes, it is not enough to analyze the hydrological conditions in the entire catchment area. The situation on the rivers in the underlying Regions also need to be taken into consideration when regulating the lakes. The minimum discharge value is 100 cubic meter per second as it is not allowed to fully stop the water flow. The average value is 220 cubic meter per second.
- It is important to include the **interest groups from various sectors** as they are all part of the same ecosystem (e.g.: Agriculture, fisheries, bird protection, the shore protection, the navigation/shipping and hydropower). The involvement of many different groups often creates **a long decision making process** that requires patience. Example of the importance of interest groups: When the gates are closed, only few fishes find the way trough. In order to answer to environmental organizations' request and give the fish more space, the "Regulierwehr Port" created a separate gateway for the fishes next to the weir.
- **Hydropower as an additional by-product**: The downward slope in the water stream at the weir is used to produce electricity from the river power plant, which has been constructed in 1995. The yearly production consists of almost 25 million kilowatt-hours.

List of Participants

Family Name	First Name	Organization
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