

Water resources and alpine rivers: adaptation to the challenges of climate change

Conference Proceedings
Annecy, 18 and 19 February 2020

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Introduction

The water conference "Water Resources and Alpine Rivers: Adaptation to the Challenges of Climate Change" held on 18 and 19 February 2020 in Annecy, was convened within the framework of the French Presidency of the Alpine Convention. It was based on the work already carried out by the Water Management Platform of the Alpine Convention and on the Alpine Climate Target System 2050 drafted by the Alpine Climate Board. The aim of the Presidency was to gather suggestions from a broad group of experts and stakeholders to come up with concrete courses of action benefitting water resources and Alpine rivers in a climate change scenario.

Unfortunately, the Alps have become a laboratory for climate change. However, on a more positive note, and considering that every challenge has become a global one, the Alps have also become a testing ground for the implementation of sustainable policies. These policies should implement nature-based solutions with a range of co-benefits. The aim of the proposals formulated at the end of the conference is to:

- contribute to the final conclusions of the Alpine Conference in December 2020 and to the future work programme of the Alpine Convention;
- more specifically, to support the operationalisation of the Alpine Climate Target System 2050 by identifying and mobilising stakeholders in the implementation of the "Water" pathways.

The first part of this document highlights the main proposals that could inspire the future work of the Alpine Convention. The proposals were put forward by the discussion tables held during the conference. The second part summarises the speakers' presentations as well as the topics emerged in plenary discussions.

The names and affiliations of the speakers and roundtable moderators, as well as the titles of the presentations, are listed in Annex 1 (Conference Programme). Abstracts of the presentations are provided in Annex 2.

Part I: Main proposals that could inspire the future work of the Alpine Convention

The proposals presented below summarize the work of discussion tables on the following subjects:

- Conservation of wild rivers
- Renaturation of degraded alpine rivers and conservation of biological corridors
- Strengthening of upstream/downstream and cross-border solidarity, optimization of water resources.
- The "Water" implementation pathways of the of the Alpine Climate Target System 2050

They are also the result of plenary discussions aimed at generating proposals for additional measures to improve the functional state of Alpine rivers and water resources. The starting assumption, drawn up during the conference, is that solutions already exist, and that they must now be shared and implemented.

1. Conservation of wild river potential

These proposals are the result of a discussion focused mainly on the threat posed by small-scale hydropower, which still often appears to many actors as a solution both for energy transition and the creation of financial resources in rural areas, while this is only partially the case. The aim was not to condemn small-scale hydropower, but rather to promote dialogue and exchange between various local stakeholders. Apparently, this issue is not sufficiently addressed in the Alps, despite the hundreds of small hydropower projects identified.

Proposals:

- Initiate exchanges at European level to eliminate the existing discrepancies between EU policies on renewable energy and on the restoration of biodiversity;
- Improve local dialogue, which is clearly insufficient, particularly between conservation and renewable energy stakeholders. More tools are required to improve debate and understanding of energy issues and the interconnections of biodiversity and renewable energy;
- Improve knowledge of hydrology, ecosystem functioning, operational tools to make the right choices;
- No installation of micro-power plants on biodiversity reservoirs, List 1 rivers, in national parks and obviously in wild rivers. In some cases, renewable energy is definitely the second priority;
- Take into account the hydrological changes linked to climate change, which means that summer low-water levels will affect project profitability (improve knowledge of hydrology in a context of climate change);
- Extend the "Wild Rivers" tool to other Alpine rivers that are not currently protected and which feature a very rich biological diversity.

2. Restoration of degraded rivers and conservation of biological corridors

Proposals:

- Promote watershed approaches, transboundary approaches when necessary, aimed at developing monitoring and early warning systems, conservation strategies for Alpine rivers, and rules for socio-economic development so as to avoid a worsening of the situation;
- Turn requirements into operational measures and concrete actions on the ground;
- Encourage the participation of local actors (educate, raise awareness, spread out knowledge) for a better acceptance of restoration projects;
- Produce model case studies, provide methodological tools applicable at the local level;

- Revitalize rivers promoting more natural dynamic conditions (compared to a reference state to be defined);
- Promote cross-border cooperation in restoration projects;
- Promote the flow of sediment from upstream to downstream where the works in place may block sediment flow in rivers;
- Revise the concept of "instream flow", which is not always appropriate, moving towards a more adaptive management of flows downstream of works that obstruct the natural stream flow;
- Put in place methodological and financial tools to monitor the long term effectiveness of implemented restoration measures;
- Preserve and reclaim the areas along watercourses (wetlands);
- Put in place effective policies for the management of invasive alien species (update species lists, propose appropriate management measures).

3. Sharing water resources and strengthening upstream- downstream solidarity

Proposals:

- Promote the development of hydro-climatic models that provide essential knowledge about the impact of climate change on water availability and demand in a given area, taking into account various scenarios based on current knowledge;
- Encourage local actors, and in particular local elected officials, to develop socio-economic development models to satisfy long term water requirements (in terms of quality and quantity);
- Propose operational governance models to ensure efficient implementation of water resource management actions;
- Promote integrated water resource management and cooperation between the countries of the Alps for a better management of water resources, natural hazards, shortages, etc. To this end, discuss the opportunity to draft a protocol of the Alpine Convention devoted to water issues;
- Better define the ecosystem services produced in the upper part of watersheds and used downstream: need for definition, classification and prioritization for inclusion into public policies (and to enable those who use these services to fund them);
- Continue monitoring water resources and water uses;
- Ensure knowledge exchange consistency;
- Develop local consultation and provide information at the local level (elected officials, citizens, tourists);

- Manage urban policy by limiting urban sprawl and promoting water infiltration at the source;
- Adapt tourism policies by taking better account of the impacts of these practices on water resources, without losing sight of the sustainability of the ecological value of the Alps;
- Promote wise use of water, with practices that consume little water and guarantee public health (tourism, types of culture).

4. Implementation of the Alpine Climate Target System 2050

The Alpine Climate Board (ACB) has reached the final stage in the development of implementation plans for ten action areas of the Alpine Climate Target System 2050. This system was adopted by the Ministers of the Alpine States at the XV Alpine Conference in April 2019. The Conference mandated the ACB to operationalise the target system and to take the first steps towards the dual objective of "Climate Neutral and Climate Resilient Alps 2050". Water is one of the domains covered by the Alpine climate target system.

Three implementation pathways were developed involving experts and various representatives (Member States, NGOs, consultants, etc.) and were presented and discussed during the workshop "Setting up teams for the implementation of the Alpine Climate Target System 2050":

- Tools and methods for drought management in the Alps;
- Implementation of an Alpine-wide approach for mainstreaming climate change into transboundary water management;
- Implementation of an Alpine-wide flood risk management, based on nature-based solutions.

Within the limited time available, the session first focused on the discussion of the contents of the pathways and then began to consider the stakeholders to be involved. The participants mentioned a wide range of stakeholders who should be invited to join the water "implementation teams": farmers, stakeholders of existing projects in flood risk management and transboundary river management, industrial associations, cultural associations with transboundary networks, companies focusing on soil and water bioengineering, universities, environmental NGOs, regions, municipalities, etc. Concrete proposals for implementation teams were also put forward: CIPRA International, WWF, Birdlife, Friends of Nature, Swiss Data Cube, INRAE (National Research Institute for Agriculture, Food and Environment, FR) and ETH Zurich (CH). It appeared crucial to use the existing know-how and expertise of stakeholders to further develop the implementation pathways.

This workshop was a pilot session for the "Matchmaking" workshop scheduled by the Alpine Climate Board. At this event, the ACB will present the implementation pathways for all the sectors covered by the Alpine Climate Target System 2050 and invite participants from all over the Alps to join implementation teams. More in-depth discussion will follow on identifying the target stakeholders, on leadership, the role of the Alpine Convention and its bodies, sources of funding and starting points to trigger the process. Potential partners recommended at this conference will be invited to the Matchmaking event, which is scheduled to take place on 30 June 2020. It will be linked to a Climate Communication Conference (30 June/1st July 2020) organised by ALPACA, the

Alpine Partnership for Local Climate Action, with the slogan, for both events, "Listening, storytelling, matchmaking".

5. Other proposals

1.1.Improving knowledge

A need for knowledge building has been expressed on many occasions, on the premise that we better manage what we know. The adaptation strategies to be developed also depend to a large extent on the actual knowledge acquired on a given topic. The Alpine range is often regarded as an open-air research laboratory. As climate change is more impactful in the mountains than in lowland regions, it seems vital to focus on the upper part of watersheds to take fast and effective adaptive measures in these areas.

Proposals:

- Capitalise on existing knowledge efforts, through a closer exchange of experience and feedback between the different Alpine areas;
- Improve ecological knowledge about high-altitude habitats, especially aquatic ecosystems, with the aim of better anticipating the measures needed to preserve them;
- Experiment with the acclimatization of species from high altitude watersheds to lowland habitats;
- Quantify and study the variability and availability of water resources over time, as a result of climate change;
- Quantify water uses;
- Improve the efficiency of wastewater treatment, including the treatment of pollutants with little or no treatment to date.

1.2.Raising awareness, consultation

Emphasis has been placed on the need for awareness-raising and consultation among the water system stakeholders (from the citizens as users of the resource, to the politicians, as those who ensure the correct implementation of water management measures). The aim is to raise collective awareness of the stakes, and gain the endorsement by regional stakeholders for a better implementation of management measures for adaptation. Knowledge is not supposed to remain the preserve of specialists!

Proposals:

- Train and inform on the status quo and the findings;
- Use existing communication tools (e.g. map of the Inn River Basin) to raise awareness among decision-makers and the local population about changes in hydrological regimes, and their impacts on water resources and river ecology;
- Adopt participatory tools, involving the citizens;

- Involve young people, include them in the decision-making process;
- Deepen the discussion on climate change mitigation policies.

1.3. Governance and public policy

- Need to strengthen and extensively apply financial incentive instruments all across the wide Alpine valleys, for instance the regional centres for integrated river basin management (IRBM), called Water Agencies in France;
- Implement reinforced governance in water management, as is the case for GEMAPI and its sector (aquatic management and flood prevention) which in France, from January 1, 2018, was attributed to public inter-municipal cooperation with an own tax system¹;
- Adapt public policies (with special reference to land use planning) to the specificities of high-altitude territories.

PART II: Conference Summary

1. Introduction to the conference

1.1. The Alpine Convention

The Alpine Convention is an international treaty signed in 1991 whose mission is the protection and sustainable development of the Alps. It was ratified by the eight countries of the Alpine range: Austria, France, Germany, Italy, Liechtenstein, Monaco, Slovenia and Switzerland, as well as the European Union. The Contracting Parties share a common territory and collaborate in various fields to contribute to its protection and sustainable development: nature and biodiversity, climate change, energy, forests, green economy, mountain agriculture, natural hazards, population and culture, spatial planning, soil protection, transport, tourism and water management.

On 4 April 2019, at the Alpine Conference in Innsbruck, France officially took over the presidency of the Alpine Convention from Austria. Brune Poirson, State Secretary to the French Minister for the Ecological and Inclusive Transition, chairs the Alpine Conference.

1.2. The work of the Water Management in the Alps Platform

The Water Management in the Alps Platform was in operation from 2009 to 2019. Throughout this period, and in the framework of the implementation of the first Action Plan on Climate Change in the Alps of the Alpine Convention, it gathered knowledge and issued recommendations on different aspects. More specifically, the Platform developed guidelines for the construction, optimisation and rehabilitation of small hydropower plants with a view to the protection of aquatic environments and biodiversity. The Platform also dealt with the management of

¹ Implementation of the MAPTAM (2014) and NOTRe (2015) Decentralization Laws. After the transposition of the 2007 Flood Directive into the Grenelle II law of 2010, these two laws specified the governance of water and aquatic environments, as well as the obligations of the communities in terms of flood prevention and management of aquatic environments.

hydromorphological processes and, in recent years, with measures adopted in the Alps to deal with drought.

The Water Management in the Alps Platform also collaborated with the EUSALP Action Group 6, jointly led by the Permanent Secretariat and the Land Carinthia, whose subgroup on water explored green infrastructure solutions.

2. Alpine rivers in times of climate change

2.1.State of play

With decreasing snow cover and melting glaciers, the hydrological regimes of all Alpine rivers are changing. The frequency and intensity of floods in autumn, winter and spring, as well as summer droughts, will increase significantly, extending intermittent river regimes. These changes will have a significant impact on water availability and the water cycle, and on an increase in natural hazards: destabilized slopes and increased debris accumulation.

High-altitude freshwater ecosystems, as diverse habitats with valuable and highly specialized biodiversity, are also highly vulnerable to the effects of climate change and indicators of alterations. Their resilience appears to be limited. Specialized species, capable of living in extreme conditions, will gradually be supplanted by more numerous and more "common" species. In addition to changes in the composition of ecosystems, the Alpine landscapes, especially the floodplains downstream, will also be transformed.

In 1992, CIPRA (International Commission for the Protection of the Alps, established in 1952) published a study indicating that only 10% of Alpine rivers could be considered to be in a good ecological status, i.e. 5,500 km out of the approximately 58,000 km of Alpine rivers surveyed. It proposed to use the "Biosphere Reserves" system to protect them.

In 2013, the WWF Alpine Programme (European Alpine Programme / Save The Alpine Rivers, EALP / STAR) published a study² showing that the situation had not really changed, both in terms of the proportion of rivers in a good ecological status (very good ecological status, since the Water Framework Directive had been issued by that date) and in terms of protection.

Still in 2013, according to IUCN, strong protection measures had been applied to only 4% of the rivers in the Alps.

In addition to these environmental predictions, societal changes (hydropower, public supply, irrigation, heating/cooling, snow production, increased land requirements for human habitats and infrastructure) will increase pressure on ecosystems, mainly in downstream areas.

2.2.Inspiring practices for the Alps

Integrated approaches at the watershed level: from knowledge about issues to the implementation of actions in the field

² Source: University of Vienna - University of Natural Resources and Life Sciences, BOKU

The main measure for anticipating the effects of future environmental and socio-economic changes is to develop integrated approaches at the river basin level, sometimes requiring transboundary cooperation. Feedback on shared experience highlights the value of participatory processes, involving all stakeholders in the region. The effectiveness of these approaches often requires good coordination between the project partners, who must appoint a common coordinator, and the local level. Developing maps and graphs to visualise the phenomena is essential to promote local understanding and ownership. The implementation of operational actions to remedy the observed conflicts requires continuity of people's engagement, participation and long term local commitment.

Preserving the still intact gems of biodiversity

In 2013, it was estimated that the remaining wild rivers in France accounted for 788 km out of the 8830 km of French alpine rivers. Since 2013, about ten sites have been labelled "Wild Rivers" in the French Alps. Hopefully other alpine jewels can be included!

Restoring degraded watercourses

River restoration, by increasing the natural retention capacity of river floodplains, is one of the concrete actions that can be implemented as part of more comprehensive adaptation strategies. Sharing the lessons learnt, as happened with the work presented on the Lysse River in France, leads to restore free space to watercourses in less vulnerable sectors, by reconnecting minor riverbeds to their related areas (wetlands playing a role in storage, purification, key biodiversity areas, etc.). It also stimulates the aquatic ecosystem (non-rectilinear profiles, concentration of water at low water levels to avoid sharp rises in temperature, etc.). These developments should not neglect the need for vulnerability management, which is constantly increasing.

3. Alpine water resources management and water-related conflicts

3.1.State of play

Climate change is manifesting itself at a faster rate in the Alps than elsewhere: since the end of the 19th century, temperatures have risen by almost 2 °C (twice as much as the average for the northern hemisphere). According to climate projections, by 2100, temperature increases in the Alps will be between +2.6 and +3.9 °C, and may reach as much as +4.2 °C above 1500 metres.

Under the influence of changes in precipitation patterns (strong inter-annual variations), soil degradation and the gradual melting of glaciers (which have already lost between 20 and 30% of their volume since 1980 and could further lose between 30 to 70% of their volume by 2050), the availability of water resources is also changing. Availability is a decisive factor for the supply of drinking water to the population as well as for the economic development of foothills and plains (agriculture, household needs, hydropower, river navigation, irrigation, tourism or cooling of thermal or nuclear power stations, etc.). This situation, combined with societal changes and increased demand from water users, tends to perpetuate and further intensify conflicts. The factors of future water availability and demand are therefore strongly affected by climate change

- which could multiply related conflicts, especially since demand is partly seasonal or time-specific (irrigation in summer, cooling during heat waves, water for artificial snow or electricity in winter) and often not aligned with natural availability.

Water quality is also affected by increasing anthropogenic pressures (persistent pollutants from industries, households, agricultural waste), especially during drought periods (low flow levels in receiving bodies and high temperatures). These conflicts are more prevalent in mountain valleys characterized by urbanization and intensive farming. Finally, climate change reinforces phenomena such as heavy erosion and landslides (increased risks for populations).

These are often cross-border issues affecting many different levels. They are also cross-sectoral and involve a wide range of users, practitioners, institutions and disciplines.

3.2. Inspiring practices for the Alps

Anticipate situations of shortages and identify critical target areas

As shown by a large-scale pilot study carried out by the Rhone-Mediterranean-Corsica Water Agency on the Rhone-Mediterranean watershed, in France, setting priorities for action in target sectors, i.e. the most critical ones in terms of water resources, is an important prerequisite for the deployment of tools, financial resources and finally for implementing actions aimed at resolving conflicts. Vulnerability maps are very helpful for targetting priority areas.

On a more local scale, thanks to the data provided by field managers, critical periods for future (or even current) more accurate water use estimates can be obtained (mismatch between available resources and water needs), when we apply different hydro-climatic and socio-economic scenarios. These modeling tools are very useful to become aware of the issues involved. Since local policies are often limited to a short time horizon, the main challenge is to encourage local decision-makers to plan the development of their territory over a longer period of time.

It is worth noting that areas under stress can initially reduce their water requirements, at least partially, through adaptation measures: four-season tourism, modification of agricultural practices (crops adapted to hydro-climatic conditions, drip irrigation). However, other, more radical measures may be necessary to meet their future challenges. Strong measures to change land use planning are sometimes needed to prevent a potentially significant impact on the local economy.

Proposing concerted and integrated actions in coherent territories: the case of watersheds

As demonstrated in the case of the Roya, the watershed level appears to be a coherent unit for managing water resources. Acting at this level requires not only cooperation between upstream and downstream stakeholders, but sometimes even transboundary cooperation regulated by international conventions. Many steps of this type have already been taken and have proved their relevance. The first step is a consultation process gathering all water management stakeholders around the table, including users, with the aim of ensuring sustainable development for these high altitude river basins. Initially, joint actions will be aimed at improving knowledge on the impact of climate change and proposing a governance model that will eventually lead to efficient management actions.

4. Conclusions of the conference

By Luca Cetara, Eurac research and Italian delegation to the Alpine Convention

1) Since many years, water has been a key subject for study and action for the Alpine Convention. This is evidenced by the "cursus honorum" recalled by the Secretary General yesterday afternoon, as well as by the preparatory documents of this conference. The latter sum up fifteen years of history, while testifying a rare case of "lifelong learning", probably associated to the substantial common identity across the Alps and the significant availability of water resources - with cultural as well as, still, scientific implications, despite climate change.

2) It is worth noting that the Water Management Platform of the Alpine Convention and the previous editions of the Conference "Water in the Alps" made important contributions to several of the topics addressed during the conference: integrated management, river development, renaturation of water bodies, impacts and adaptation to climate change, droughts, opportunities and risks of hydropower production, sediment transport, implementation of the EU Water and Flood Directives in the Alpine region, flood risk management and the introduction of a new voluntary governance of water resources through tools such as river contracts.

3) On closer examination, one of the reasons why water has become so "popular" in times of climate instability is probably that climate change primarily affects water resources: from droughts to floods and water availability in a state not matching the demande i.e. little snow and a lot of water in rivers, for example, to mention a topic dear to the Alpine tourism sector.

4) It is no coincidence that climate change steadily recurs in speakers' reports, participants' concerns and management student projects. The first conclusion, not an original one, is that we must continue to address this challenge, with particular reference to a sensitive issue like water management in the Alps.

5) In the Alps we are probably not used to considering water as a scarce resource, at least historically. This makes the reduction scenarios relatively more dramatic than elsewhere: there is a subtle difference between an already critical situation (typical of other environments where water resources are scarce in absolute terms) and a potentially critical situation (where a reduction prospect of more than 30% could reverse sustainability conditions).

6) Consider the runoff reduction scenarios presented for Lower Engadine in the next 30 years: it might be more complex to manage a relative shortage in the heart of the Alps than to manage an absolute shortage in a desert region, because of the intensity of the variation and its effects in absolute terms.

7) In line with the traditional approach of the Alpine Convention with reference to water resources, we have listened to several examples of integrated resource management (the river basin committee and the Water Agency in the case of Annecy, for example, but also the Autonomous Province of Bolzano/Bozen and the Roya transboundary river contract). They show a wide variety of approaches applied throughout the Alpine regions, possibly suggesting a role for the Convention in proposing how to bring together the main management methods adopted in the Alps.

(8) We might assume a need for governance methodologies for complex (water) systems and coordination between EU directives, jurisdictional systems, regulations and national guidance,

which could support examples of concerted action for sustainable management of water and the associated ecosystems. The Alpine Convention could probably cast light on them and promote the exchange and synthesis of best practices; many were already presented (Bolzano/Bozen, Annecy, Engadine, Inn).

9) We know that the Floods Directive calls on us to consider water as a (healthy) vector of natural risks and that the Water Platform of the Alpine Convention calls for a combined application of the Water and Floods Directives. Many local authorities and civil protection systems have at their disposal an enormous amount of information on floods, damages, affected regions and have tried to identify the responsibilities of the different public and private bodies in planning operations, areas of responsibility and, last but not least, financial resources - as these are usually very costly interventions. Even more in line with the spirit of the Treaty, the wish has been expressed for a joint commitment by the Contracting Parties regarding the implementation of Article 8 of the Flood Directive. Pursuant to Article 8, international coordination is required to draw up a single flood risk management plan for transboundary river basins shared with other Member States or third countries.

10) It would be ambitious and even a bit boring to try and summarize yesterday's plenary debate and also the specific outcomes of roundtable discussions, even for this forum. I will therefore confine myself to a few comments concerning on the one hand, the history of the Alpine Convention and its water-related activities, and on the other hand, the challenges underlying the conference we are about to close.

11) The restoration of watercourses and renaturation of Alpine water bodies in accordance with the aims of European directives, not always easy to implement due to the ecological and morphological conditions of Alpine rivers, are expressly included in the first challenges taken up today.

12) The preservation and conservation of intact river ecosystems - the first challenge - probably requires a common identification of these water bodies in the Alpine region and a relatively homogeneous approach to their management in ecological, economic and regulatory terms. A non-binding identification of these ecosystems in the Alpine region would probably provide a scientifically based framework for policy makers as well as the regional and local administrators involved in the management choices related to these ecosystems.

13) Alpine specificity is of course equally related to high altitude environments, which might be more or less impacted by the global hydrological cycle, and showing consistent patterns in different parts of the Alpine range.

14) Let me also mention the other important topics of communication and citizens' involvement that have emerged. They remain a key reference for any democracy and the main source of funding for the work and measures suggested here. Just yesterday, one of the comments showed how citizens' participation becomes even more desirable when planning funding and expenditure that directly affect them. An increased awareness of the complexity and multiple benefits that can result from the sustainable management of a resource now subject to the fierce law of scarcity, can be seen as an opportunity for the Alpine Convention to play a role of "social sustainability".

15) In this respect, many enlightening experiences with tools clearly oriented in this direction have been carried out: the maps shown to us by many speakers have the merit of immediacy, not to mention the superb video.

(16) From a geomorphological point of view, the analysis of the documents produced by the Convention on the subject seems to highlight the issue of sediment transport both from the point of view of preserving the natural character of rivers and of reducing hydrogeological and hydraulic risk, with obvious impacts also on the production of hydroelectric power.

17) The second challenge addressed by this conference is the restoration of degraded Alpine rivers and the conservation of their ecological corridors, with a view to reduce soil degradation and its impacts on water bodies and the use of "stream branching" and "natural regulation" techniques. There are good examples of efforts made to find the proper balance, albeit they are obviously prone to criticism because of the perfectibility of human action. In areas devoted to production (agricultural and often also urban and industrial), some interventions are complex and can generate conflicts related to preserving the distinctive elements of the Alpine landscape, the most profitable cash crops and, in general, past land uses. The question about what are the physical and ecological characteristics that make a renaturation intervention possible, feasible and desirable in an Alpine environment, in accordance with the Habitats Directive, might certainly be raised within the framework of the Convention itself.

(18) River basin governance must necessarily include upstream and downstream areas, acknowledging the mountain contribution to water supply and the ensuing benefits. However, there is a need to generate a shared governance system that should not be perceived as top down. Conversely, the benefits for all areas (and parties) concerned should be clearly recognized for all the parties involved, and more information spread on them – not an easy task, only hinted at in welfare economics textbooks.

19) In this (potentially limitless) field, the use of resources, as well as finding agreement on it, play a key role. While mountains provide most of the ecosystem services related to the availability, quality and regulation of water resources, this does not mean that their provision comes for free. We often recognize opportunity costs, i.e. what we could do but decide not to, or use of resources we do not take advantage of, to allow ecosystem services to flow. In other cases, the costs are directly related to carrying out activities to improve the flow or use of these services.

20) Public policies at all levels have so far been focused on measures related to water supply: efforts have therefore been made to increase resource availability to meet the demand of fairly heterogeneous categories. Conscious water demand management is probably becoming relevant to the Alps too, although in the past, water availability was never perceived as a challenge. The feasibility of this approach depends to a large extent on the degree of user awareness about services that in the Alpine environment may require more punctual explanations than elsewhere. But it also depends on the use we will be able to make of it and on the deliberate actions taken by the Alpine Convention to bring out the topics emerged in the discussion of these two days to contribute to the implementation of the new CAP and the European Green Deal, which are expected to fulfil many of the wishes shared here.

21) Some voluntary instruments already exist, they are rather frequently applied in some Alpine countries. They could provide a relatively well-defined structure for this type of exchange and are

increasingly being applied across borders, as we have heard in the case of Inn and Roya, to name but two examples.

22) The fourth challenge is the implementation of the climate objectives approved at the last Alpine Conference in Innsbruck, also for the water sector.

23) Finally, it should be noted that - incidentally - in each of the areas examined, appropriate modes of action for active implementation or support by the Convention and its organs have been indicated, considering the international character of the instrument. They should be taken into account so as to develop a pan-Alpine action for the management and protection of Alpine water resources in the context of climate change.

24) At the same time, there is probably a need to identify and define the legal and financial instruments required for adoption by administrators, stakeholders and citizens, as well as any good practice that would help to successfully tackle the range of critical issues affecting a river basin - with particular reference to the priority challenges identified by the Convention over the years and those discussed during these two days.

Annexes (to be added)

- **Annex 1: Conference Programme**
- **Annex 2: Presentation Abstracts**
- **Annex 3: Implementation pathways of the Alpine Climate Target System 2050 in the water sector**