



Convention of the Protection and Use of
Transboundary Watercourses and International Lakes
Task Force on the Water-Food-Energy-Ecosystems Nexus
Fifth meeting

Geneva, Switzerland, 18 October 2017

REPORT FROM THE GLOBAL NEXUS STOCKTAKING WORKSHOP¹

held at the Palais des Nations, Geneva,
6-7 December 2016

I. Background to the Workshop

The nexus in the Water Convention's programme of work

The global stock-taking workshop on assessments of the water-food-energy-ecosystems nexus and response measures in transboundary basins took place in the Palais des Nations in Geneva on 6 and 7 December 2016, back to back with the fourth meeting of the Task Force on the Water-Food-Energy-Ecosystems Nexus (Geneva, 8 December 2016). Since the decision of the Meeting of the Parties (MoP) to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) in 2012 to embark on assessing intersectoral issues in transboundary basins, the nexus has been one of the areas of work under the Water Convention. Subsequently, since 2013 the UNECE and partners have undertaken the nexus assessment of six different transboundary basins using an assessment methodology developed specifically for participatory assessments of the water-food-energy-ecosystems nexus in transboundary basins.² In practice, the assessments have involved consideration of intersectoral links, trade-offs and benefits in managing water, land, energy and environmental resources in transboundary basins, from the perspective of both technical and governance perspectives. The Task Force on the Water-Food-Energy-Ecosystems Nexus, with Finland as the lead Party, is responsible for activities related to the water-food-energy-ecosystems nexus.

Countries from within and beyond the Pan-European area show growing interest in this approach. Beyond the nexus work under the Water Convention, numerous other studies have been carried out and tools have been developed to improve the understanding of the nexus at different contexts and scales. The advancement of the series of assessments under the Water Convention and other progress with applying the nexus concept made it timely to take stock of experiences gained and share lessons, with a specific focus on the transboundary context. For these reasons, the MoP included in the programme of work 2016-2018 organization of a global stocktaking workshop on the nexus assessment and implementation of the nexus (intersectoral) approach in transboundary basins.

The global workshop and its objectives

With the overarching purpose to inform cross-sectorally coordinated and integrated efforts to promote sustainable development, the workshop had the following specific objectives:

- Review key methodologies and initiatives of relevance for assessing nexus issues in transboundary basins;
- Draw lessons learned from the assessments carried out;
- Formulate conclusions and recommendations regarding assessment of nexus issues, but also policy recommendations for more sustainable development of different resource management sectors ;
- Identify good approaches as well as policy and technical measures for addressing intersectoral issues; and
- Discuss how a nexus approach can be put into practice in resource management, at the basin level in particular, and how processes that foster intersectoral coordination can be supported.

¹ The initial draft was prepared by Lucia de Strasser.

² More information on the UNECE approach, methodology and case studies can be found at: <https://www.unece.org/?id=43460> and <http://www.unece.org/index.php?id=45241>

The workshop programme was organized into the following sessions:

- 1) Key methodologies and initiatives of relevance for assessing nexus issues in transboundary basins;
- 2) Lessons from basins which have been assessed / studied;
- 3) Nexus solutions; and
- 4) Basin cases and how a nexus approach could be put into practice.

The conclusions from the workshop guided the discussions in the meeting of the Water Convention Task Force on the Water-Food-Energy-Ecosystems nexus which will meet just after the workshop (Geneva, 8 December 2016). This report focuses on capturing the main elements of the discussions, hence complementing the presentations and descriptions of the approaches to and tools for assessment of the intersectoral issues and dynamics. Documenting conclusions from the workshop serves development of the future work of the organizing partners to foster transboundary cooperation and provide assistance to countries and joint bodies, such as transboundary commissions.

This workshop report first illustrates the variety of methods and projects that were presented during the workshop, with the objective of informing on the current state of applying the nexus approach as a tool for supporting policy-making; then it includes key lessons learned from nexus work at transboundary level; finally it reports on nexus actions and solutions developed so far to address intersectoral issues in the form of: information, instruments (e.g. economic and policy instruments), infrastructure, and international coordination and cooperation.

The workshop was organized under the leadership of the Government of the Finland, with the support of the UNECE secretariat of the Water Convention. Funding for the workshop and the nexus assessments under the Convention was provided by Finland, Germany, Italy, Sweden and Switzerland. The following organizations are partners in organizing this workshop: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), the European Commission, the Global Environment Facility (GEF), and the GEF Project International Waters Learning Exchange and Resource Network (IW:LEARN), Global Water Partnership, and the International Union for Conservation of Nature (IUCN).

Introduction: Value of the nexus to resources management and development

With the adoption of the Agenda 2030 and the Sustainable Development Goals (SDGs), it is clear that as the SDGs on energy, food security, water and ecosystems – and beyond – are closely interlinked, there can be trade-offs involved in their simultaneous attainment³. Therefore, an intersectoral (nexus) approach is expected to add value by supporting dialogue about the impacts, priorities and choices related to progress in different areas of sustainable development.

There is wide consensus on the fact that work on the nexus, including efforts such as promoting intersectoral coordination, should build on what already exists. This is important not only to learn from the past and avoid repeating the same mistakes, but also to establish partnerships⁴ in order to join efforts on priority areas: in this case, transboundary cooperation. As examples of where the nexus approach is used to complement existing regional programs where water-using sectors are already some degree involved in basin level cooperation, e.g. in the Niger (in partnership with the Joint Research Centre of the European Commission) and Mekong (with the Mekong River Commission) river basins.

³ Interactions between SDGs can be more or less important and can be positive (enabling simultaneous implementation) or negative (hindering simultaneous implementation). The International Council for Science (ICSU) proposes a draft framework for understanding and classify these interactions: <http://www.icsu.org/publications/reports-and-reviews/working-paper-framework-for-understanding-sdg-interactions-2016/SDG-interactions-working-paper.pdf>; Regarding interlinkages of the SDG 6 on water and sanitation with other SDGs, the analytical brief “Water and Sanitation Interlinkages across the 2030 Agenda for Sustainable Development” (UN-Water, August 2016) can be referred to: http://www.unwater.org/publication_categories/policy-and-analytical-briefs/

⁴ This is in line with SDG 17 “Strengthen the means of implementation and revitalize the global partnership for sustainable development”

II. Different approaches to assessing the nexus

A variety of methodologies exist to undertake nexus assessments. Many of them have been developed in the past few years as the nexus concept gained the attention of international organizations and research institutes involved in the implementation of the Agenda 2030 and its Sustainable Development Goals (SDGs). For comprehensive lists please refer to (FAO, 2014)⁵, (ESCWA, 2015)⁶ and (IRENA, 2015)⁷.

During the Global Nexus Stocktaking Workshop, a number of practitioners presented their different approaches and illustrated their applications in a number of projects (see Table). Common denominator of all presented methods is that they are developed to support decision making, especially in developing countries, and that they do so by providing insights on intersectoral issues arising from the multiple use of finite resources as well as, to a certain extent, proposing solutions. At the same time, the scale at which they are applied, their qualitative or quantitative nature, and the entry point that they take to the nexus, can be quite different reflecting a variety of perspectives, mandates, and priorities.

Table: Nexus approaches presented at the UNECE Global Stocktaking Workshop

What	Who	How	Where	Entry point: Nexus
Integrated assessment modelling	International Institute for Applied Systems Analysis (IIASA)	Quantitative	Regional (transboundary basin), global	Food and energy security: Water, Energy, Food
Integrated resource evaluation model CLEWs	KTH Royal Institute of Technology, division of Energy System Analysis (KTH-dESA)	Quantitative	City, national, regional, global	Resource security and greenhouse gas emissions: Climate, Land use, Water, Energy
NEXUS WEFE ICT tool (e-NEXUS Module) for water resources management	Joint Research Centre (JRC)	Semi-Quantitative	Regional (transboundary basin)	Food security and environmental issues: Water, Food, Environment
Participatory nexus for improving transboundary cooperation	United Nations Economic Commission for Europe (UNECE)	Qualitative	Regional (transboundary basin)	Cooperation on shared water resources: Water, Energy, Food, Ecosystem
Knowledge support for developing “nexus-sensitive” policies in	Food and Agriculture Organization of the United Nations (FAO)	Semi-quantitative	National	Food security: Water, Energy, Food

⁵ Food and Agriculture Organization of the United Nations (FAO). Walking the nexus talk: Assessing the water–energy–food nexus in the context of the sustainable energy for all initiative. 2014 Available at: <http://www.fao.org/3/a-i3959e.pdf>

⁶ United Nations Economic and Social Commission for Western Asia (ESCWA). *Conceptual Frameworks for Understanding the Water, Energy and Food Security Nexus*; ESCWA, Beirut, Lebanon, 2015. Available at: <http://css.escwa.org.lb/SDPD/3581/WP1A.pdf>

⁷ International Renewable Energy Agency (IRENA). Renewable energy and the water, energy and food nexus. 2015. Available at: http://www.irena.org/DocumentDownloads/Publications/IRENA_Water_Energy_Food_Nexus_2015.pdf

agriculture				
Interactive platform for scenario analysis with real-time feedback to achieve multiple SGDs	Millennium Institute	Quantitative	National, regional	All sectors and resources: (including) Land, Soil, Water, Energy, Biodiversity
Integrated and interconnected management for minimizing environmental risk and ecological degradation	United Nations University, Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES)	Semi-Quantitative	Local, national	Natural resource efficiency and environmental protection: Water, Soil, Waste
Integrated planning (place-specific)	International Institute for Sustainable Development (IISD)	Semi-Quantitative	Local, regional	Resource use: Water, Energy, Food, Ecosystems
Nexus mainstreaming in German development cooperation	German Development Agency (GIZ)	Qualitative	National, regional (informing global agenda)	Development in water sector (drinking and sanitation): Water, Energy, Food

Depending on the mandate of the institution, the nexus approach can be used as a ‘conversation opener’ for broader cooperation (e.g. UNECE) or as a means to investigate challenges in the implementation of multiple sectoral policies, either by providing scientific support to decision makers on specific issues (e.g. JRC, IIASA) or by addressing the responsibility and accountability of various sector and identifying areas where institutional capacity needs strengthening (e.g. GIZ).

Essentially, the nexus approach is used to answer two questions. First, how can resources be better distributed so as to ensure that all needs (including environment preservation) are satisfied? And secondly, how can we improve the overall efficiency of our resource use, thereby reducing our environmental footprint? These two questions require analysts to investigate, on the one hand, intersectoral dynamics to identify areas where cooperation can be improved (e.g. environmental regulation), and on the other to compare, using appropriate tools, the effect of various options for policy action on multiple sectors (e.g. climate action).

Typically, this requires working along two lines, one of institutional analysis – sometimes expanded to be, more broadly, a governance analysis - and one of natural resource modelling – from resource stocks to transformation and multiple uses. Depending on the relative importance of modelling, quantitative aspects can be more or less prominent, if not absent from, a nexus assessment.

Even though the overall workshop focused primarily on transboundary basins and regional cooperation, an effort was made to ensure that the presented projects were representative of the entire spectrum of possible application scales of the nexus approach, from global to local (see Box 1). Actually, most approaches are designed to be applicable at various scales, a challenging objective that requires analysts to frame nexus problems against very different contexts, e.g. global issues, international relations, country security problems, local impact of national and sub-national policies and actions.

This multi-scale feature of the nexus influences the choice of stakeholders that need to be involved in the assessment process. Because of their central role in policy making, key national actors such as sectoral ministries are typically, at least, consulted. However, some projects then require the involvement of local actors such as farmer organizations, city councils, and local NGOs, while others engage more with regional and international bodies, such as river basin organizations and trade associations.

Given the broad variety of perspectives, each of the presented approaches has a different entry point to the nexus, which defines its specific set of nexus components. Although the ambition of the nexus approach is to eliminate the bias to a specific sector (indeed, this multi-centric nature of the nexus is what differentiates it from other integrated approaches, e.g. Integrated Water Resource Management)⁸, an entry point can well be one specific resource (with its multiple uses) or one specific sector (and its multiple resources). This is the case especially when the nexus assessment is carried out by an organization with a sectoral mandate.

For instance, the nexus of FAO stems from agriculture, the one of UNECE does it from transboundary water cooperation, and the one of GIZ from the water management/services. However, this is not necessarily the case as the entry point can be a multi-sectoral, or multi-resource question. Among the examples are IIASA, that investigates how to achieve food and energy security at the same time; the Millennium Institute that, similarly, looks at the simultaneous implementation of the SDGs; UNU-FLORES that looks at how to improve efficiency and reduce impact in the use of natural resources; JRC works on water, food and environment at basin level, down-scaled from models of more regional extent. Finally, KTH-dESA and IISD define their entry point (and design their approach) depending on the specificities of each single project.

Box 1: Examples of findings from nexus works at various scales- a non-comprehensive list⁹

Transboundary

The Alazani/Ganykh. Ecosystem service as valuable link between energy and water sectors. While Azerbaijan has successfully combined its reforestation plan in the basin area with a policy of fuel substitution, deforestation in upstream Georgia is still largely due to a lack of clean and affordable alternatives to woodfuel. As reforestation becomes important not only at national level (improving health in households) but also at basin level (to limit floods downstream), the assessment under the Water Convention identifies room for knowledge sharing.

Continent/Country

Africa/Uganda. Climate uncertainties affecting investments in large energy and water infrastructure. Investing in large dams for irrigation and hydropower in Africa will require planning for resilience because various climate scenarios do not give consistent results. In particular, an increase or decrease in rainfalls with respect to a fixed assumption can result in dams to be under-or over-sized. The World Bank supports countries in developing the capacity of planning under uncertainty.

Island

Mauritius. Sugar or biofuels? By investing in cogeneration it is possible to move away from sugarcane production and increase the production of biofuels. This leads to reduced imports of fossil fuels, reduced CO2 emissions, and reduced expenditures. However - counterintuitively - as water will become scarcer, the country, which relies heavily on hydropower, need to invest in desalination, which in turn could result in higher coal consumption. As these considerations would not be grasped without a nexus approach, country authorities recognized its importance for the island's development planning.

⁸ Bazilian et al.,. Considering the energy, water and food nexus,. Towards an integrated modelling approach. *Energy Policy* (2011)

⁹ elaborated from: Mark Howells, Keynote presentation. Available from: <https://www.unece.org/index.php?id=41736#/>

State

Punjab (India). Long term effects of cheap energy for irrigation. With generous subsidies for irrigation, groundwater has been withdrawn faster than it was naturally replenished. Agricultural land turned into a desert, deeply compromising local food production. Moreover, this affected the state's energy consumption: as aquifer depths increasing, more and more energy is needed for irrigation.

City

New York City. A case for cooperation between energy and water utilities. A study on bathroom appliances showed that improving efficiency in water use reduces energy consumption, e.g. lower-flow shower heads means less energy to warm water up, and low-flow flushes means less energy to pump it and treat it. If utilities work together efficiency is mutually improved. On a large scale like that of New York City, this can have a significant impact.

There is a growing body of knowledge about intersectoral links and trade-offs between water, energy, land/agriculture and environment in transboundary basins. A number of organizations, of which only few are mentioned here, have looked into the relevance of the nexus concept in their work. These organizations include regional bodies (e.g. the Mekong River Commission), international organizations (e.g. FAO) and large funders (e.g. the Global Environment Facility), while under the UNECE Water Convention, a specific effort was made to develop a consistent approach applicable in very different contexts (e.g. after several application in river basins, it is now being applied to an aquifer).

Other than being an occasion to share views and reviewing different approaches, this workshop allowed to share lessons learned from the various applications of a nexus approach to assessing challenges in resource management and discuss potential improvements to it. The following Sections focus mainly on transboundary basins, however many considerations may hold true for other contexts as well.

III. Lessons learned from assessments of the water-food- energy-ecosystems nexus

An increasing number of applications of the nexus approach show that similar issues may arise and solutions may turn appropriate, respectively, in different contexts. Tools and processes to carry out integrated assessments that consider multiple resources, “nexus assessments”, are becoming more specific and targeted to respond to a wider variety of questions¹⁰. As a result, discussing lessons learned so far from various projects can help moving forward both in terms of knowledge of nexus dynamics and practice of how to address them, always keeping in mind that there are no universal solutions applicable everywhere and that grasping the local context remains the first priority of any nexus assessment.

Challenges

The workshop session on lessons learned was introduced by three presentations, all of them focusing on work that is being carried out in Africa. The first one, presented by the Joint Research Centre of the European Commission, illustrated its cooperation with the European Commission's International Cooperation and Development (DEVCO) and the German Development Agency (GIZ) on developing scenarios to explore agriculture, energy and environmental challenges both in Africa and the Mediterranean region (AFRIMED project). Then, the National Water Partnership of Benin (NWP Benin) introduced their project “Water for growth and fight against poverty” in the Mekrou basin (a sub basin of the Niger), with involvement of the Niger Basin Authority and other stakeholders that aims at developing a shared strategy for poverty alleviation and long-term growth in the basin area. The third presentation was delivered by the Nile Basin Initiative and focused on cooperation instruments, such as the Nile Basin Decision Support System as a tool for decision making in the context of upstream-downstream water allocation.

¹⁰ See the following repositories of projects, papers etc: <https://www.water-energy-food.org/start/>; <http://www.waternexusolutions.org/1x8/home.html>; <http://www.thenexusnetwork.org/>

While the first presentation highlighted similarities across the African region, the second and third pointed at specific problems, which can be of outmost importance in the local context but are easily neglected in the global nexus discourse. NWP Benin named in the Mekrou Basin transhumance, sanitation, and pollution from cotton plantations as core problems, while NBI mentioned the construction of new large infrastructure, which will require developing capacity for technical cooperation and trust building. One clear message from all presenters was that international organizations play a key role in promoting (and sponsoring) intersectoral dialogue at transboundary level.

As already highlighted in the publication *“Reconciling resource use in transboundary basins: Assessment of the water-food-energy-ecosystems nexus”* (UNECE, 2015), riparian countries face common challenges related to the reconciliation of national strategies – often related to water, energy and food security - and transboundary relations – normally involving agreements on water allocation and environmental conservation. In other words, typical issues in transboundary basins are: conflicting uses of common water resources, regulation of flows, and transboundary environmental impact.

Putting in place efficient mechanisms of cooperation able to address these transboundary, nexus issues can be particularly challenging because it requires overcoming differences in regulatory and legislative frameworks and governance cultures, among others. These are all aspects that need to be harmonized in order to be able to effectively take action at regional level. Moreover, the physical link of water makes trade-offs and impacts propagate across sectors affecting a variety of stakeholders at different geographical scales, and this calls for the involvement of institutions at different administrative levels.

Information

In order to give meaningful insights to policy makers, a nexus assessment needs to bridge global considerations (e.g. climate change) and local issues (e.g. loss of livelihoods). This requires combining highly aggregated data with context-specific information, which in turn requires a deep knowledge of the local context. A lack of reliable data – either not measured or not accessible – is a relatively common constraint, especially in developing countries. This is usually critical as it limits the ability to understand dynamics between sectors and resources in their complexity, and in turn the opportunity to use a nexus approach as a means to improve cooperation. Furthermore, even where data is available, accessible and usable, there can be challenges in processing and analyzing it. Typical obstacle may arise from having to deal with different methods of collecting and measuring data, or with large data gaps caused by a long term interruption of measurement.

A positive lesson learned is that the use of a nexus approach in transboundary basins allows to improve the understanding of intersectoral issues while keeping a “water lens” to the problem. This mutual understanding needs to be sought between countries and sectors that have to face a number of different challenges, some of which in common. “Speaking different languages” may complicate forming a common understanding.

As sectors evolve commonly in relative isolation and interlinkages between sectors and resources become more pressing, the ability to measure, forecast, and monitor changes can be a key asset for sensible regional planning. This often requires the development of new databases and data processing methods, although building on existing sectoral databases and their linking. Depending on the context, modelling can be important to forecast changes in climatic conditions, glaciers melting cycles, land use, river delta shrinking, flooding, and so on. To do so, it is important to combine existing knowledge generated and gathered in different sectors by different kind of actors (e.g. private companies and public administrations) and join efforts.

In terms of approaches to carry out nexus assessments, multicriteria evaluation can be powerful in the comparison of strategy alternatives. Also, uncertainty analysis should be always incorporated in any quantitative analysis of the nexus.

Participation and ownership

Ensuring ownership of the assessment process is as important as raising awareness on nexus issues. National and local actors should be at the centre of each assessment not only to ensure data reliability and capture the specifics, but also to establish priorities for action, create networks, and translate theoretical solutions into policy action. With this perspective, it becomes fundamental to involve not only local decision makers and stakeholders affected, but also local experts and researchers - which in turns requires international analysts to work closely with local experts and researchers.

The involvement of key stakeholders can be provided in different ways. The approach under the Water Convention for instance is to start the dialogue from high-level mandate to develop the mandate to undertake a nexus assessment and develop it gradually in cooperation with local institutions, operators and utilities, and academia. Actually, improving technical knowledge and developing platforms of cooperation are two parallel, mutually reinforcing areas in nexus assessments under the Water Convention). In particular, the involvement of local partners can be decisive, resulting in reaching out to the “right” individuals. In some cases, in order to trigger actual action, it will be necessary to involve stakeholders that are not in the water, energy, and food sectors, or even economic development and regional planning - an example of key decision makers in transboundary basins can be the ministries of foreign affairs. It is interesting to note that the selection of stakeholders for involvement in the process is not only basin-specific, but can also be problem-specific. The NBI, for instance, proceeds with a new mapping, selection and engagement process for every project. Although less developed than top-down ones, bottom-up approaches are more appropriate because they allow for a better participation of local stakeholders.

By improving dialogue at different levels, the nexus can help addressing unresolved issues between neighbouring countries pertaining to water allocation and transboundary impact. It is important to manage expectations though, because political will remains a *sine qua non* for international cooperation. Sometimes, small steps forward that improve trust among riparians can be already considered a good achievement. Indeed, increasing trust is key in transboundary contexts, as any cooperation requires some level of information sharing.

Overall, convincing the relevant decision makers to take an active role in intersectoral, transboundary cooperation can turn out to be quite challenging. Transboundary cooperation generates multiple benefits – also in the private sector - but in order to actually trigger joint action they need to be understood by the concerned stakeholders and communicated to decision makers. Still, some sectors and countries have more (economic, strategic) power than others, and may have little incentive to engage in this type of dialogue.

Among the lessons that basins can exchange, among of the most relevant are: 1) effective international agreements and institutional arrangements (e.g. inter-governmental working groups) that have been set up to face nexus challenges at transboundary level and 2) applicable economic and policy instruments set up to address issues in different countries (see next section).

IV. Nexus solutions or good practices in addressing the nexus

There are different types of synergetic actions, or “nexus solutions”, to address intersectoral issues. They can be categorized in many ways, the UNECE for instance uses the following: institutional arrangements, information, instruments (e.g. economic and policy instruments), infrastructure, and international coordination and cooperation. As the second part of the workshop focused on emerging good practices and effective solutions coming from concrete examples, the following paragraphs aim at capturing what was discussed, both in plenary and in groups. It should be noted that, due to time constraints, the discussion revolved largely around multipurpose infrastructure.

Financing measures with a multi-sectoral dimension

To address the identified intersectoral challenges, infrastructure is in a key role, and more and better investment into water infrastructure is necessary. Especially in contexts of water scarcity - be it

natural or economic, meaning that accessing it is resource consuming and expensive - nexus solutions will require investments in the water sector. Compared to other sectors, such as transport and energy, this sector typically receives low investments because of the difficulty to recover costs through water tariffs and make economies of scale for large infrastructure, which is why water infrastructure is typically financed by the public sector or by large donors, through grants. For private sector financing to be available for countries, a safe environment for investments is a pre-requisite.

The point was made that ideally international financing institutions should fully integrate a nexus approach into their funding decisions, considering the basin as a whole. Investing in multi-purpose infrastructure may allow for splitting costs (and return on investment) across sectors. Currently, only a fraction of water infrastructure around the world is multi-purpose, however there are several examples available.

The European Investment Bank (EIB) showed that while normally EIB finances sectoral investments (e.g. energy, agriculture, etc.), inter-sectoral projects are starting to gain importance - for example within the Natural Capital Financing Facility NCFF. At least in Europe, international banks are financing more and more project that generate revenues or save costs (e.g. payment for ecosystem services, green infrastructure, organic cosmetics, and eco-tourism).

Regional planning in transboundary basins is highly supported by the international community. The Global Environment Facility (GEF) for instance offers a structured process to build a basin vision and addressing competing uses of water: first, a Transboundary Diagnostic Analysis (TDA) and then a Strategic Action Program (SAP). While the TDA is a technical document meant to investigate the basin issues, the SAP focuses on actions and investments. The objective of this process is to point at concrete investment opportunities and plans to improve the legal and institutional frameworks for cooperation.

Integrating environmental protection considerations

Among the many problems is the alteration of natural flow and its consequences on riverine ecosystems. Major infrastructural interventions always alter the natural environment to an extent that is difficult to completely offset by compensation measures. Nevertheless, infrastructure development projects generate revenue that can support environmental protection or development measure in other sectors. An examples of this is the Itaipu dam, which provides 75% of Paraguay's electricity demand, and 15% of Brazil's. The project allowed for the establishment of 10 protected areas, including a bi-national reserve. Biodiversity corridors have been recovered, native/medical plants are being cultivated. A variety of activities take place in the reservoir laboratories (e.g. climatology, pisciculture, integration of solar and bioenergy, environmental education, support to farmers and indigenous colonies).

The last decades have seen investments in large dams increasing in many areas of the world, also as a result of the renewed interest in developing renewable energy sources as part of a wider effort for more sustainable energy generation, including reduced greenhouse gas emissions. In hydropower development, a trade-off with the environment is very present, and the possible alternatives to the projects as well as the most appropriate ways to mitigate the environmental impact vary. Defining and implementing environmental flows is one means: No universal methodology is available to calculate them but the experience is developing. More generally, in many countries environmental legislation is not adequate or not sufficiently implemented in this sense. Land ecosystems similarly suffer: as nature conservation efforts are rarely given the priority to economic development, habitats are not usually taken into account when selecting the location of new infrastructure.

Sustainability, risks and uncertainties

When developing an infrastructural solution, it is important to acknowledge that there is always a certain level of risk that will need to be managed. What if the assumptions made were turned out inaccurate? What if not all partners manage to take action as planned? What if political changes slow down processes or if attitudes are not favourable towards cooperation? These and other risks make the implementation process long and demanding, which requires governance to be up to the challenge.

In large transboundary basins one of the most pressing issues is assessing the sustainability of new hydropower projects. Pre-evaluation process for investments would need to have intersectoral effects (externalities) considered. As of today, there are instruments available to do that, however they are not universally adopted. Examples are Environmental Impact Assessments for single projects, Strategic Environment Assessments for regional development plans, and protocols such as the Hydropower Sustainability Assessment Protocol.

Fostering political commitment with objectives

The SDGs can be a catalyst for multi-purpose infrastructure. The nexus concept links the SDGs, and the benefits of using a nexus approach to the definition of development opportunities is precisely the fact that the coherent implementation of the SDGs is taken into account at the planning stage.

Improving transboundary cooperation is explicitly part of one of the targets of the SDG on clean water and sanitation (SDG 6), with a devoted global indicator¹¹. Coordination between resource sectors (notably: water supply, energy production, and agriculture) and cooperation between riparian countries in transboundary basins where impacts of sectoral management can spread from one country to another is complex but necessary. Cooperation and coordination between neighbouring countries is helpful towards achievement of other SDGs also, notably on energy (SDG 7) and food security (SDG 2).

Implementation of solutions and supporting it with appropriate institutional frameworks

Resource management solutions cannot be limited to the supply side, as in many cases investments are also needed in the demand side (e.g. water and energy use where efficiency and rational use can be promoted) and/or in regulation and monitoring. These aspects are all fundamental to the achievement of the SDGs, and require finding solutions within and beyond the technical sphere: There may be “green” (nature-based) alternatives to technical measures and infrastructure solutions need to be complemented with “soft” measures, including those from policy side. If on one hand access needs to be improved regardless of the profitability of investments, on the other the governance of water management needs to be effective in terms of delivering a service (water supply), in harmony with other sectors, and without compromising the environment.

National and transboundary governance

Putting solutions into practice can be challenging, which is why it is important to empower local “champions” who can follow the implementation process step by step. However, most challenges do not depend on them, but rather on the country and basin situation. Results-oriented management may hinder slow processes, such as more consultative processes. At the level of national administration, actions need to be detailed taking into account national priorities and targets and mapping intersectoral impacts.

There may be a gap between what is aspired for and stated in a policy document or a law and the extent to which it is actually implemented, or enforced. This may occur for different reasons, including capacity or resource constraints. Similarly, committing to implementing solutions within the framework of a nexus assessment might not in the end be followed up with concrete action, and the need in some cases for more than one sector to act may be an additional complicating factor. Value was seen in developing intersectoral or inter-ministerial action plans, based on existing good practices.

National or transboundary governance structures may not be well set-up to favour intersectoral action. Their gradual development may have resulted in parallel or overlapping structures; or the sectoral basis of organization, issues of hierarchy or shortcomings in participation of different stakeholders might lead to inefficiency or hinder addressing intersectoral issues effectively.

Once again the transboundary dimension adds to the complexity, so that not only implementation needs to take place within each country, but also across the border. This means that, despite differences in ways of approaching problems and strategic priorities for development and

¹¹ SGD 6 “Ensure availability and sustainable management of water and sanitation for all”; Target 6.5 “By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate”

intervention, countries need to join efforts on common issues or at least coordinate actions for effectiveness and for reducing negative impacts. Political issues may arise, as countries may not be willing to compromise on their development plans or share the burden of expensive measures. Indeed, financing remains one of the major obstacles to the implementation of solutions, together with political issues and lack of institutional capacity.

In basins shared by multiple riparians, when multilateral agreements are difficult to attain, bilateral ones should still be considered as they can provide for some specific transboundary issues to be addressed among fewer riparians. For instance, effective transboundary cooperation is needed to ensure that infrastructure is operated in a way that takes different water needs (also in different riparian countries) into account and minimizes impacts. Discussing the situation in different areas of the world revealed this to be one area where governance solutions are urgently needed.

Searching for opportunities out of the water box

Keeping in mind socio-economic development at basin level, there can be trade opportunities, and other benefit exchanges. Sometimes other sectors can provide good prospects for transboundary, regional cooperation (e.g. increasing energy trade and interconnectedness) *beyond the river*¹². Hence the opportunity to use the nexus approach not only to investigate cross-sectoral impacts, but also to propose synergies and solutions, out of the “water box”.

Establishing clear indicators to measure the impact of proposed solutions across sectors and the joint identification of economic and non-economic benefits associated with them emerged as important factors determining the efficacy of nexus solutions. It is worth stressing here again the importance of not only identifying benefits, but also effectively communicating them to the actual decision makers at national level.

As examples of solutions “out of the water box”, can be cited from the Syr Darya River Basin, where reconciliation of water uses for hydropower and irrigated agriculture remains challenging, developing the energy trade potentially plays a major role in the development of the energy sector of all the countries and measures including restoring the regional electricity grid would help the related benefits to be better realized. The development of a regional market for agricultural products similarly has strong potential to positively influence economic growth in the countries in the region, as well as their choice of crops.

By proposing an equal representation of sectoral policy objectives, the nexus approach offers the opportunity to better involve multiple sectors in the dialogue over the management of common water resources¹³. It is important to recognize that an imbalance in sectoral representation is a potential obstacle to make the best of this opportunity, which is often the case. Adopting a nexus approach does not guarantee in itself a successful reach out to the other sector. As dialogue over transboundary cooperation has been traditionally sectoral - at most inclusive of other sectors, with Integrated Water Resource Management - broadening the scope of cooperation requires concerned institutions to develop and open up. Adaptive institutions to be able to work at different scales were seen as having particular potential for addressing nexus challenges.

In order to ensure ownership of the assessment process and allowing for tailored investigation of solutions, open-source databases and tools can be instrumental. A good example is the case of Bolivia, where the UN Department of Economic and Social Affairs (UNDESA) engaged in a process of capacity building for the benefit of the Ministry of Energy, using an open source energy modeling tool (OSeMOSYS). This tool has allowed local planners to develop a strategic plan for the electricity sector including unconventional sources, tailoring the model to the specific needs of local planners. A similar approach has been taken in the Drina river basin (as part of the UNECE project), where a simplified open-source model of all basin's hydropower plants was developed study the benefits of more

¹² Sadoff and Grey, *Beyond the river: the benefits of cooperation on international rivers*. Water Policy (2002)

¹³ de Strasser et al., *A Methodology to Assess the Water Energy Food Ecosystems Nexus in Transboundary River Basins*. *Water* (2016)

coordinated operation and water releases from dams and the findings were presented to national authorities.

V. Conclusions and way ahead

Some conclusions can be drawn from the discussions at the workshop.

The SGDs implicitly call for the nexus approach to sustainable development, including at transboundary level. There are direct and indirect interlinkages between goals, and in particular between SDGs 2,6 and 7. In particular, improving transboundary cooperation - a specific target under SDG 6 - will require broadening the scope of regional cooperation beyond the river. Even if not explicitly monitored, cooperation can support implementation of other goals also.

There is a growing body of knowledge of nexus dynamics and tools. The diversity of approaches, case studies, indicators and proposed solutions only reflects the flexible definition of the nexus, at times understood as a set of physical interlinkages between resource flows, at times as a set of challenges (including impacts) between sectors in resource management. Instead of the negative effects, the nexus can be seen as a useful trigger to improve coordination and cooperation. The scoping and focus in nexus studies at times spreads across two sectors (e.g. water and energy), at times many more. Finding a tool that is fit-for-purpose and appropriate for the local conditions is key.

Different resources in focus in the water-food-energy-ecosystems nexus play out at different scales, with effects at multiple levels: water within hydrological boundaries, energy inside power grids, food along trade routes, and land and ecosystems stand are more stationary. This has significant consequences on governance, and translates into the need to address nexus challenges together with authorities working at different levels.

National or transboundary governance structures may not be well set-up to favour intersectoral action, due to e.g. sectoral boundaries and a lack of cross-cutting mechanisms. The existing structures and nevertheless be built upon to improve governance across sectors.

Many transboundary basins share common issues related to water allocation and environmental impact. Usually, these are politically sensitive and improving dialogue is challenging. In principle, the nexus approach can help broadening it by introducing new elements and opportunities “out of the water box”, such energy sector measures, trade and land management. However, challenges remain in terms of reaching out to the right stakeholders and decision makers, and involving them. Better communicating the nexus approach and benefits of cooperation will help in this sense.

International agencies and donors play a significant role in promoting regional planning and transboundary cooperation. As national interests and regional interdependencies push in often different directions, the role of global and regional institutions becomes central as well as that of large financiers of development such as multilateral banks, with their guidelines and requirements for approval of projects and related consultations. Although the practices vary, a number of development partners are increasingly adopting a nexus approach to transboundary issues, and will keep on working in this direction (see Box 2). The civil society plays an important role in following the processes for development projects, in particular to ensure consideration of local interests and environmental concerns.

Zooming in, pressing intersectoral issues can manifest themselves at the local level, and they may differ from those prominent at the basin or transboundary level. Looking at large basins and discussing common transboundary issues can hide the local dimension of the nexus. However, what local populations experience is the result of national policies (or lack of) at local scale. When issues relate to livelihoods, these become of primary importance independently from their ‘position’ in the nexus. This is why understanding the local context should remain a priority of any nexus assessment.

Environment and ecosystems in the background. One big issue when it comes to identifying nexus solutions is that environment and ecosystems typically remain in the background with respect to the other components of the nexus, i.e. resources or economic sectors (water, energy, and food).

Considering the central role of the environment in supporting livelihoods, one of the concluding points of the workshop was that too little was said about ecosystem services. Instead, it is important to talk more about the how preserve them and start valuing environmental conservation, beyond the economic benefit that it may deliver in the short term through e.g. tourism. Integrating environmental protection into sectoral policies and planning is a means of applying a nexus approach.

Data gaps will always exist, but they should not hold back analysis of nexus issues and solutions, and addressing them through resource management decisions. Integrated analysis requires data covering different sectors. Typically some kind of data is available to start with. Often, there is more than what analysts tend to expect, but accessing it may be challenging. Nevertheless, the value of countries sharing a resource agreeing on a qualitative basis about priority issues should not be underestimated. Data sharing will always be challenge for political reasons. In these cases there is remote data (satellite imagery). Despite its limitations, it can provide some indicators that are immediately comparable across countries.

Link to on-going processes that can support operationalization of policy recommendations. Find and work with national and international processes (such as the EU Water Initiative's National Policy Dialogues).

The way ahead

The aim of this workshop was twofold: on the one hand, to review what is the current understanding and practical application of the nexus concept, and on the other to discuss possible management responses in the light of expectations from Governments as well as from organizations for transboundary cooperation (notably river basin organizations).

The experiences shared at the workshop, the discussions and the conclusions informed the 4th meeting of the Task Force on the Water-Food-Energy-Ecosystems Nexus under the Water Convention. This input will also be used for development of a synthesis document on the nexus assessments work carried out under the Convention. The awareness about the tools presented will contribute to reflection about what is available to support countries to move on and quantify some of the priority intersectoral issues identified to explore policy options.

The workshop programme was enriched by a number of examples and many experiences related to initiatives of the organizing partners. Through their active participation, the workshop served provision of feedback and insights to initiatives on the water-food-energy-ecosystems nexus (or a part of it) either on-going or under development at the time of the workshop. Some of these are briefly described in Box 2.

Box 2. Outlook to nexus- related work of key international organizations¹⁴

The European Commission (EC) supports a regional approach to the nexus, building on what already exists, e.g. in Africa, and anticipated to keep on working with basin organizations and their well-established networks. The JRC will coordinate knowledge management and dissemination. This partnership is being promoted by the Swedish International Development Agency (SIDA) and the Swedish International Water Institute (SIWI). Priority is given to facilitating investments of intersectoral importance, in particular multi-purpose water infrastructure, but also to projects that address the big challenges of displacement/migration and climate change.

Like the EC, the German Development Agency (GIZ) will keep a regional approach, working with regional and country offices in the MENA region, Latin America, Africa and Central Asia. This will allow GIZ to share lessons learned across regions. GIZ's focus will be on developing concrete actions and providing assistance especially in capacity development (currently a huge gap).

¹⁴ Elaborated from a panel discussion in the 4th meeting of the Task Force on the Water-Food-Energy-Ecosystems Nexus (Geneva, 8 December 2016).

From the perspective of the Global Environment Facility, funding is needed before, during and after the process of understanding nexus dynamics. It is a long process of building trust, share information, and engage in cooperation. IW-LEARN can be used as a platform for ensuring transparency in modelling tools and mainstream knowledge management and dissemination mechanisms.

Global Water Partnership, a multi-stakeholder platform, working with national authorities and regional organizations, can be useful in bringing in stakeholders, in particular basin organizations and national authorities. In particular, with regard to the nexus assessment work under the Water Convention, GWP can help the project opening up to regions beyond the pan-European area. As migration is a key topic, GWP-Mediterranean has already related activities in cooperation with the Union for the Mediterranean.

The International Union for the Conservation of Nature (IUCN) will keep on using the nexus as an instrument of diplomacy, as illustrated by its current efforts in the Mekong region. IUCN also plans to expand the understanding of the Nexus, e.g. through land management, which is often a forgotten element, and ecosystem-based or ecosystem-related solutions. Given that there are still gaps in the nexus in what terms of what it means and what benefits it brings, an effort will be made to improve communications.

Organization of American States (OAS). Before applying the nexus approach in Latin America, it is important to systematize the nexus process. Countries need to have a shared vision that reflects the basin context, as the nexus can be very different between Caribbean and South America. OAS hopes to collaborate on UNECE and others in the region.