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Working Group on Integrated Water Resources Management

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Item 8 of the provisional agenda

Thematic assessment of the water-food-energy-ecosystems nexus

Draft assessment of the water-food-energy-ecosystems nexus in the Sava River Basin

Prepared by the secretariat with input from experts

Summary

At its sixth session (Rome, 28–30 November 2012), the Meeting of the Parties to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes requested the Task Force on the Water-Food-Energy-Ecosystems Nexus, in cooperation with the Working Group on Integrated Water Resources Management, to prepare a thematic assessment focusing on the water-food-energy-ecosystems nexus with a view to its publication prior to the seventh session of the Meeting of the Parties (see ECE/MP.WAT/37, para. 38 (i)).

The present document contains the draft summary nexus assessment of the Sava River Basin. The draft assessment is the result of an assessment process carried out according to the methodology described in document ECE/MP.WAT/WG.1/2015/8 developed on the basis of a desk study of relevant documentation, an assessment workshop (Zagreb, 4-6 March 2014), as well as inputs from local experts and officials of the Sava countries. The draft assessment of the Sava was circulated for review and comments to the authorities of the riparian countries and stakeholders in January 2015 and a further revised draft assessment was made available for review and comments on the website of the International Sava River Basin Commission (ISRBC) on 10 April 2015. Subsequently, a stakeholder consultation workshop on the findings of the assessment was organized by the ISRBC on 25 May 2015 in Zagreb.

A more detailed nexus assessment report, on which this summary is based, is available in document ECE/MP.WAT/WG.1/2015/11.

This summary will eventually be included in the final version of the assessment publication. For background information on the methodology and for the decisions that the Working Group on Integrated Water Resources Management may wish to take, please refer to document

Contents

INTRODUCTION

Aim, objectives and scope

1. The assessment of the water-food-energy-ecosystems nexus in the Sava River Basin aims to support transboundary cooperation by Sava countries in the areas of water, energy, food and environmental policies by strengthening the knowledge base for integrated policy development and decision making.

2. The specific objectives of this nexus assessment are:

- to identify key drivers of the different sectors that can cause adverse pressures and impacts on water, energy, ecosystems and food security;
- to draw implications for the transboundary river basin based on national findings;
- to outline the potential to support and increase additional benefits that could be achieved in the basin through more coordinated policies and actions, and through transboundary cooperation;
- to identify policy measures and actions that could alleviate negative consequences of the nexus and help to optimize the use of available resources (under future environmental and climate constraints); and

3. The assessment also contributes to the implementation of the Framework Agreement on the Sava River Basin (FASRB): further integration of water policy with other policies, as well as further dialogue with key sectoral stakeholders, have been set in the Strategy on Implementation of the FASRB as specific objectives in the field of river basin management.

The scope of this nexus assessment is limited to providing a preliminary overview of the relevant issues. This preliminary analysis (largely qualitative) could them serve as the basis for more detailed analyses.

Assessment process

4. The Nexus Assessment in the Sava Basin was carried out with and at the request of the International Sava River Basin Commission (ISRBC). The analytical work was carried out by the Royal Institute of Technology KTH, in Stockholm (technical aspects) and by the Central European University (governance). It was complemented by modelling by the European Commission's Joint Research Centre's (JRC).

5. The Sava Nexus assessment made use of a multi-stakeholder approach involving representatives from the different sector ministries and various interest groups relevant to the nexus from five Sava countries: Slovenia (SI), Croatia (HR), Bosnia and Herzegovina (BA), Serbia (RS) and Montenegro (ME).

6. Information for the pilot Nexus Assessment of the Sava Basin was gathered through (i) an inter-sectoral workshop that took place in Zagreb from 4 to 6 March 2014; (ii) two questionnaires, one factual (filled by local experts) and one perception-based one (distributed at the inter-sectoral workshop); and (iii) a desk-review of relevant documentation provided by the workshop participants.

7. The consultation on the findings involved a circulation of the draft assessment for review and comments to the authorities of the riparian countries and stakeholders in January 2015, the

website of the International Sava River Basin Commission (ISRBC) on 10 April 2015 and organization of a stakeholder consultation workshop (25 May 2015, Zagreb).

Basin overview

8. The Sava basin is a key basin in the Western Balkans. It covers considerable parts of Slovenia, Croatia, Bosnia and Herzegovina, Serbia, Montenegro and a very small part of Albania[1]. Indeed, a large part of the population of most riparian countries lives in the basin: 75% Bosnia and Herzegovina, 61% in Slovenia, close to 50% in Croatia, over 30% in Montenegro and close to 25% in Serbia. A significant share of water, hydropower, land area and economic activity is derived from basin – for example 53% of the riparian countries[2] electricity generation capacity is located within the basin.

9. The Sava basin is part of complex network of transboundary waters. The Sava River, which emerges in the mountains of western Slovenia and flows into the Danube in Belgrade (Serbia), is the Danube's third longest tributary (about 945 km) and the largest by long term average discharge (1,722 m^3/s, at its mouth). In turn, the Sava river receives water from a number of tributaries, many of which are also transboundary – such as the Drina.

10. The Sava basin is has a varied morphology, geology, and ecology. The upper part is dominated by rugged mountains (the Alps and the Dinarides), while the middle and lower parts are characterized by flat plains and low mountains -- elevation varies between 2,864 m a.s.l. and 71 m a.s.l. Diverse geological structures and a complex tectonic setting determine the type of aquifers that occur: the Pannonian area with dominant inter-granular aquifers, the Dinarides with mostly limestone aquifers, and some karstic areas. The basin hosts large lowland forests, the largest complex of alluvial wetlands in the Danube basin (Posavina - Central Sava basin), seven designated Ramsar sites[3], and a number of areas of ecological importance are under national protection status. Figure 1 provides an overview of the different classes of land cover.

11. The Sava basin's natural resources are key for the current and future development of the riparian countries. Water and land resources support significant agricultural production, power generation, navigation – see Figure 1. The Dinaric Karst Aquifer is the main source of drinking water for some countries. The presence of some intact floodplains supports both flood mitigation and biodiversity conservation. Parts of the basin enjoy a very favourable environment for hydropower generation. Thanks to its pristine natural ecosystems and the availability of recreational water-based transport, the Sava Basin already attracts tourism, and has the potential to attract more tourism related activities. Forests and wetlands have provided an array of ecosystem services to people living in the surrounds -- from aesthetics to wild food, fuel and timber – that are interwoven with local culture and livelihoods. The basin's resources also contribute to significant reductions in greenhouse gas emission due to the low carbon electricity production that supports. This includes high levels of hydropower production, cooling of the region's nuclear power plant and a number of thermal power plants, supplying balancing services for the introduction of solar and wind, as well as the high levels of carbon dioxide sequestered in forests and wetlands.

[1] Due to the small share of the river basin, Albania was not involved in the assessment process.
[2] In this case Bosnia and Herzegovina, Croatia, Montenegro, Serbia, Slovenia
[3] Cerknica Lake (SI), Crna Mlaka, Lonjsko Polje, Mokro Polje (HR), Bardača (BA), Zasavica, Obedska bara and Peštersko polje (RS)

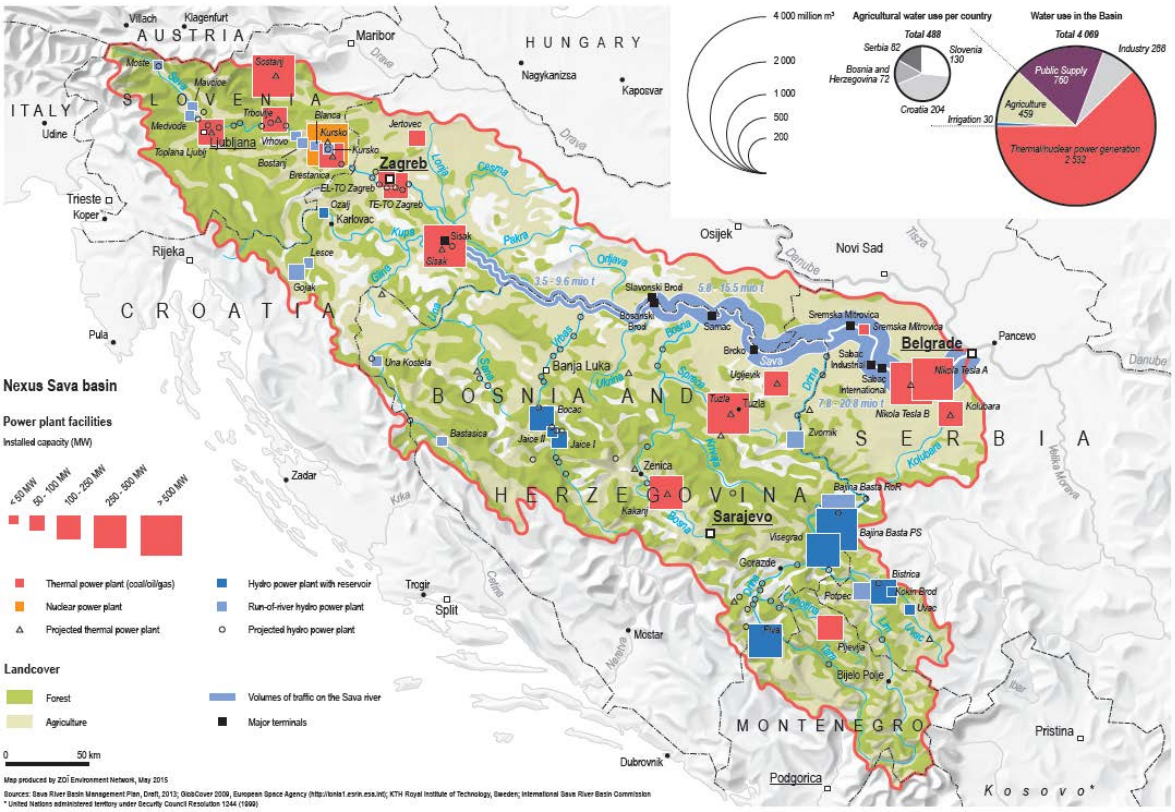


Figure 1. Map of the Sava River Basin illustrating the distribution Nexus components of energy and food (land and agriculture), and indicators of agricultural production at national level. Hydropower is not included in the pie chart of major water uses.

DESCRIBING THE GOVERNANCE CONTEXT

Basin-level governance

12. **Governance of water resources.** Water governance at basin-level is well developed. The Framework Agreement on the Sava River Basin (FASRB) provides the legal and institutional framework for cooperation, while the International Sava River Basin Commission (ISRBC) operates as implementing body of the FASRB. The ISRBC provides a framework for the establishment of joint objectives that can be implemented by countries in different stages of development, for example through adoption of the "Policy on the Exchange of Hydrological and Meteorological Data and Information in the Sava River Basin." It also serves as a forum where different interests (such as recreation and tourism, industry, agriculture, or navigation) are represented and can discuss issues of common concern as well as agree the coordinated implementation of relevant activities. The ISRBC's Public Participation Plan, finalised in 2014, presents a good basis for further activities on strengthening public participation and stakeholder involvement in implementation of the FASRB. The general public is informed of progress with FASRB implementation through the ISRBC's

website[4] as well as various publications and releases. A proposed Sava Water Council that would increase stakeholder involvement and give a greater voice to stakeholders is in the planning stages.

13. **Governance of other basin resources.** Involving the energy and agricultural sectors in basin level coordination is still at an early stage. Closer coordination of Sava countries in the energy sector will likely be driven by EU policies – such as the comprehensive EU strategy on climate change and energy currently under development. Through flood risk management coordination — implementation of the EU Floods Directive — attention is paid to land use aspects.

14. **Cross-sectoral governance at basin level.** The ISRBC coordinates the development of various intersectoral plans, among them the River Basin Management Plan according to the European Union Water Framework Directive (WFD)[5]. The Strategy for the implementation of the Framework Agreement on the Sava River Basin envisages further integration of water policies with other sector policies. Financial aspects of multi-level governance aimed at a nexus approach are routinely considered within the FASRB.

Supra-basin governance

15. **European Union**. The European Union (EU) has a major influence in developments in the Sava basin. While only Slovenia and Croatia are member of the EU, all Sava countries have taken steps towards EU accession. As a consequence, all Sava countries have made commitments derived from the *acquis communautaire* (EU Law) that affect water, energy, environment and food (agriculture and land management) policies – such as the EU Water Framework Directive and its daughter directives, different energy directives and strategies, the Common Agricultural Policy, the Rural Development Policy, or a number of environment directives such as the Habitats Directive. For Slovenia and Croatia, EU membership means that compliance with the acquis is a matter of treaty obligation, and is enforced by the European Commission as the guarantor of the Treaties. For non-member states, commitments are a part of the closure of particular chapters in the accession process, and are subjected to progress monitoring, without specific sanctions other than delay in accession. The Sava countries typically have specific institutions dedicated to EU integration and may adopt specific national strategies for approximation or transposition. The EU integration process also includes possibilities for financing activities aimed at reaching cross-sectoral integration goals (see Box 1).

Box 1. Access to EU funds

The process of EU accession generates costs as well as opportunities for funding. The Sava countries include EU member states (Slovenia, Croatia), EU candidate countries (Serbia, Montenegro) and potential candidates (Bosnia and Herzegovina). The water-related EU directives, especially the Urban Waste Water Treatment Directive, are expected to place a substantial financial burden on the Sava countries. At the same time Sava countries can access a number of EU funds. EU Member States can access funds from the LIFE program (for environment and nature conservation and biodiversity), the Cohesion Fund (for environment, energy efficiency and renewable energy), and the Common Agricultural Policy (agriculture). Non-EU countries can access EU funds through the Instrument for Pre-Accession Assistance (IPA), which provides support in areas such as cross-border cooperation, regional development and environment.

[4] www.savacommission.org

[5] Sava River Basin Management Plan. (Zagreb, International Sava River Basin Commission, March 2013). Available at http://www.savacommission.org/srbmp/en/draft

16. **Danube basin**. Since the Sava basin is a sub-basin of the Danube basin, the overall governance of the Danube basin influences decisions made at the level of the Sava basin. Regional cooperation on the Danube in the area of water is governed in part by two conventions - the Danube River Protection Convention (DRPC), under which the International Commission for the Protection of the Danube Basin (ICPDR) is established, and the Convention Regarding the Regime of Navigation on the Danube (Belgrade Convention), under which the Danube Commission is established. Cooperation between the ISRBC and the two Danube Commissions (ICPDR and Danube Commission) is formally based on memoranda of understanding signed with both commissions separately. The ISRBC participates actively in projects and initiatives across the Danube River Basin. Cooperation is enhanced by mutual participation at sessions, expert group meetings and other events of the commissions. The ISRBC has also played a role in the implementation of the EU Strategy for the Danube Region.

17. **UNECE region**. The Sava countries are parties to the Espoo Convention on Transboundary EIA as well as to its SEA Protocol (except Bosnia and Herzegovina which is a signatory). They take part in regional water cooperation mechanisms, such as the UNECE Water Convention (all riparian states are parties), and its Water and Health Protocol (Albania, Bosnia and Herzegovina, Croatia and Serbia are parties, while Slovenia is a signatory).

National-level governance

18. **Legal and institutional frameworks.** In Sava countries, the national administrations have achieved substantial progress in harmonization with EU legislation. The local level remains of special importance for creating rules and norms that are grounded in the specifics of the locality and implemented by the local authorities. At the same time, coherence between national policies and their local implementation needs to be ensured.

19. **Multi-level governance**. The Sava countries vary greatly in terms of institutional structures and degree of decentralisation. For example, Bosnia and Herzegovina's constitutional framework has led to the development of relatively few national-level strategies, and existing national-level strategies face implementation problems at the level of entity (or in some cases cantonal) governments. Given that 40% of the Sava River Basin is within the territory of Bosnia and Herzegovina, this is a significant factor to be taken into account in basin-wide planning and implementation efforts. By contrast, Slovenia does not have regional (i.e. sub-national) level institutions and the implementation of national strategies, laws and regulations is under the control of national-level institutions.

20. **Cross-sectoral governance**. Thanks to better understanding of substantive issues and changes in institutional set-up and procedures, decision-making processes increasingly integrate cross-sectoral issues. For example, periodic state of the environment reports contribute to informing the development of policies in sectors such as for industry, agriculture and energy. Nevertheless, obstacles to multi-sectoral governance remain.

21. **Water governance.** For some time, international institutions and assistance programs have identified the problems related to water management in some Sava riparian countries to include

"inadequate institutional structures".[6] The volatility of the configuration of ministries and their constant restructuring poses problem for effective governance. Sometimes water management falls under the competencies of a multiple ministries, such as in Montenegro where water competencies are divided among six ministries with the Ministry of Agriculture and Rural Development in the lead. Some countries have established horizontal multi-stakeholder coordination bodies, with varying degrees of effectiveness. Local governments play a key role in water supply, wastewater collection and sewerage services, and wastewater treatment, while water management enterprises perform operational activities in the field of water management. Meanwhile, the application of the subsidiarity principle has accelerated the trend towards shifting responsibility for financing of environmental and other infrastructure towards decentralised local government, particularly for wastewater collection and treatment infrastructure. However, while public needs may be better identified at the local level, greater decentralisation has resulted in fragmentation of efforts and in insufficient capacity and resources at the local level. In some riparian countries, the lack of a regional level authority combined with a high degree of municipality autonomy has created a governance gap in environmental performance.

22. **Policy development in nexus sectors.** International cooperation has led to the adoption of a number of measures at national level. Many national strategies and action plans are driven at least in part by EU requirements or requirements associated to international funding. For example, Croatia is typical of the region in terms of adoption of various strategic documents on environmental aspects relevant to nexus issues, including the Environmental Protection Strategy, the Environmental Action Plan, the Strategy and Action Plan for the Protection of Biological and Landscape Diversity, the Waste Management Strategy, and the Waste Management Plan (2007-2015), among others.

23. **Policy implementation on the nexus resources**. The Sava countries vary greatly in terms of implementation capacities and resources. The water and energy sectors are highly regulated, and Biodiversity protection is also generally under state supervision, due to the need to achieve certain protection goals and in some cases to enforce stringent conservation principles.

- *Water*. The EU *acquis communautaire* in the field of water management has profound importance for furthering sustainable water use and pollution reduction and control. Slovenia and Croatia are implementing the requirements of the Urban Waste Water Treatment (UWWT) Directive according to the commitments and deadlines set down in the respective accession treaties with the EU (i.e., 2017 for Slovenia and 2023 for Croatia), while the approximation of the water-related directives has advanced at different stages in the Sava countries that are not EU Member states. For example, in Bosnia and Herzegovina in 2011 the Water Framework Directive was fully approximated in Republika Srpska, and 90% approximated in Federation Bosnia and Herzegovina; while the corresponding figures for the Urban Waste Water Treatment Directive were 41% and 35% respectively.

- *Agriculture*. Governance mechanisms involving self-regulation of private actors are especially significant in the agricultural field, given the fact that small farmers own more

[6] World Bank. Issues and direction. Vol. 1 of Water resources management in South Eastern Europe. Washington, D.C., International Bank for Reconstruction and Development, 2003.
Amar Čolakhodžić, Marija Filipović, Jana Kovandžić, and Stephen Stec, The Sava River: Transitioning to Peace in the Former Yugoslavia, in *Water and Post-Conflict Peacebuilding*, Routledge, 2014.

than 85% of the total agricultural area in the basin and the economic importance of the agricultural sector is high. While at national level all Sava countries have ministries of agriculture, local farmers are important self-regulating actors who often apply good agricultural practices voluntarily. Agricultural practices are largely determined through relationships on a national level among farmers (often self-organized into cooperatives) and local authorities, with linkages to other interest groups such as environmental authorities, consumer groups and other NGOs.

- *Energy*. All the Sava River Basin countries belong to the Energy Community either as EU member States or as parties to the Energy Community treaty. The treaty provides for the creation of an integrated energy market (electricity and gas) among the European Union (EU) member States and other contracting parties. The European Council adopted the 2030 Framework for Climate and Energy Policies that includes targets on, for example, greenhouse gas emissions, the share of renewable energy and energy efficiency.

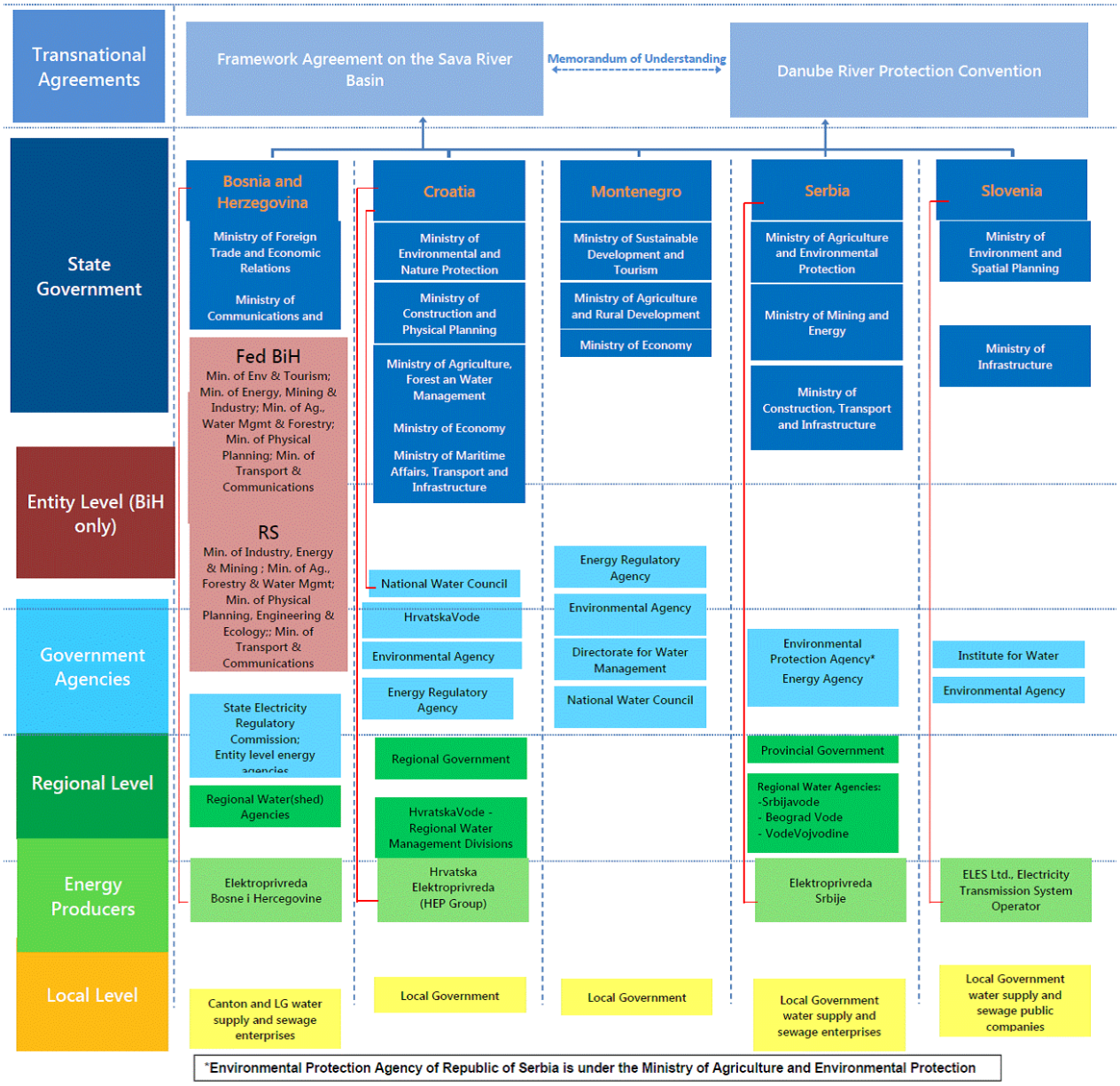
- *Environment*. While best practices in environmental permitting are promoted through various mechanisms (including EU legislation, OECD Guidelines, and expert networks), in some countries the water permit is still separate from other aspects of integrated permitting. As EU members, Croatia and Slovenia have transposed the Integrated Pollution Prevention and Control (IPPC)[7] and Seveso directives[8] into the national legislation, but the other Sava countries have also introduced IPPC into their legislation. While understaffing is still a problem, capacities of inspectorates have increased in recent years and national inspection authorities play an important role in enforcement and in ensuring compliance with relevant regimes. Standards for permitting, inspection and enforcement with regards to facilities covered under the IPPC and Seveso frameworks include methodologies for coordination with stakeholder agencies. Some Sava countries have in place environmental funds, including Serbia, which has a fund established under the Law on Environmental Protection, and Bosnia and Herzegovina, where the entity funds became operational in 2010.

24. **Monitoring in nexus sectors.** Monitoring capacities vary widely throughout the basin. There is no basin-level monitoring system, but national monitoring systems are gradually becoming better integrated. However, the region is still characterized by highly specialized bodies that possess specific information relevant to their responsibilities, with few mechanisms for sharing of information, accessibility of information (particularly by the public) and comparability of information. Some monitoring capacities have improved (e.g., water quality monitoring in the framework of the ICPDR), while others remain basic (e.g., biodiversity monitoring). A major focus of resources in this area should be on developing broad, open, transparent and efficient platforms for reliable, high-quality data to serve as the foundation for high-quality decision-making. The development of such platforms is another area where public capacities, knowledge and expertise can be deployed.

[7] Directive 2008/1/EC of the European Parliament and of the Council of 15 January 2008 concerning integrated pollution prevention and control.
[8] Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC

25. **Public participation and information**. The Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention) and the EU legislation adopted for its implementation facilitate coordination and cooperation across sectors. The Sava countries have developed extensive practice in implementation of provisions related to access to environmental information and public participation in environmental decision-making. More needs to be done, however, to aggregate the outcomes of public participation at specific decision-making levels in order to take these into account at more strategic levels. In addition, public participation has to be maintained and even strengthened in connection with specific-level decisions that are highly relevant to the nexus approach, such as in connection with climate change adaptation.

Figure 2: Institutional structure relevant to FASRB and DRPC



Sources: Developed in the present assessment using information from the literature review and inputs from local experts (see "Annex on institutional governance and legal frameworks" at http://www.savacommission.org/announce_detail/55)

IDENTIFYING DRIVERS OF PRESSURES ON BASIN RESOURCES

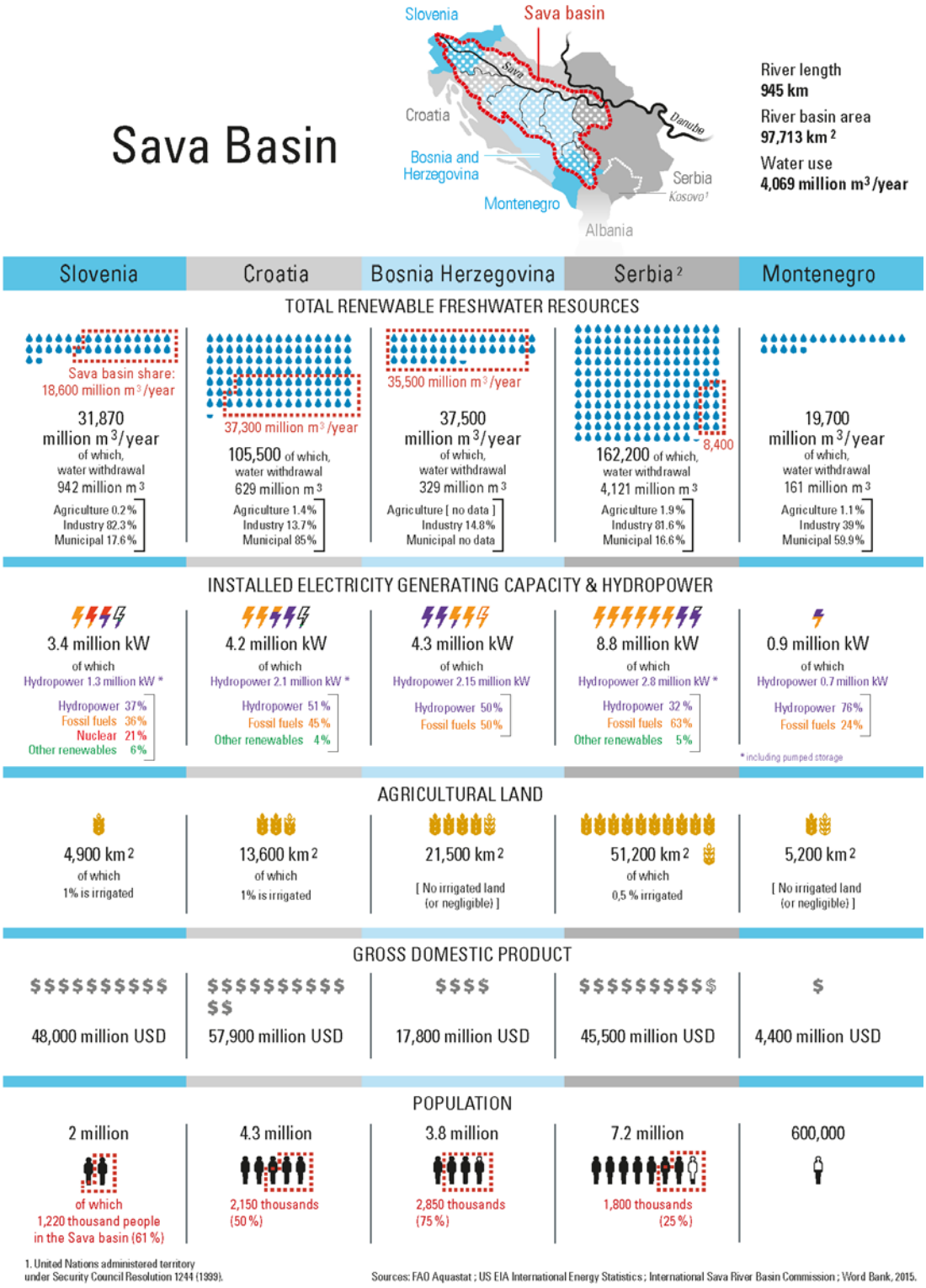
26. Use of water, land and energy resources in the Sava Basin will increase over the next 15 years. Figure 3 illustrates how the riparian countries compare in terms of resource base (freshwater, installed energy generation capacity, land resources) as well as economic and demographic size. Water usage for irrigation remains small for the time being but is expected to increase. Even if the countries in the basin have energy efficiency targets and policies, energy generation is also set to expand – partly through renewable sources. Indeed, energy security and trade are key concerns of the systems expansion.

27. Economic development will be the main driver of the expected expansion in resource use in the basin. Economic activity in the Western Balkans is expected to grow faster than the EU average. Efforts to maximise job creation will continue to be important in the region. This is likely to affect in particular resource-based sectors, such as agriculture (and agro-industry) and tourism (including eco-tourism and water-transport tourism). Agriculture in the Sava Basin currently represents between 5-10% of total employment in the region (i.e. all riparian countries), while larger employment potential linkec to potential expansion of agricultural area (which currently represents 42% of the total Sava Basin area) and agro-industries. The use of Sava Basin's river network for transport (of goods as well as people for recreational purposes) will intensify with economic growth -- but in order maintain the transport routes, sedimentation and river levels need to be maintained.

28. Climate change policies will affect the relative pressures on different resources. Each riparian will be subject either to strict EU targets[9] and / or targets they communicate to the United Nations Framework Convention on Climate Change (UNFCCC). Key to meeting these will be the deployment of more hydropower, other renewable energy technology, maintaining terrestrial carbon stocks (in wetlands and forests as well as land-use change). Adapting to climate change is a key challenge faced by all riparian's. This may include facing lower water availability and higher water requirements for example in agriculture, as well as ensuring adequate flows of water to maintain ecological systems.

[9] In the area of climate change and energy sustainability, the targets of Europe 2020 strategy are as follows: reduction of greenhouse gas emissions at least by 20% lower than 1990, 20% of energy from renewable energy sources and 20% increase in energy efficiency. *Source*: EUROPE 2020: A strategy for smart, sustainable and inclusive growth, Communication from the Commission COM(2010) 2020 final (Brussels, 3 March 2010)

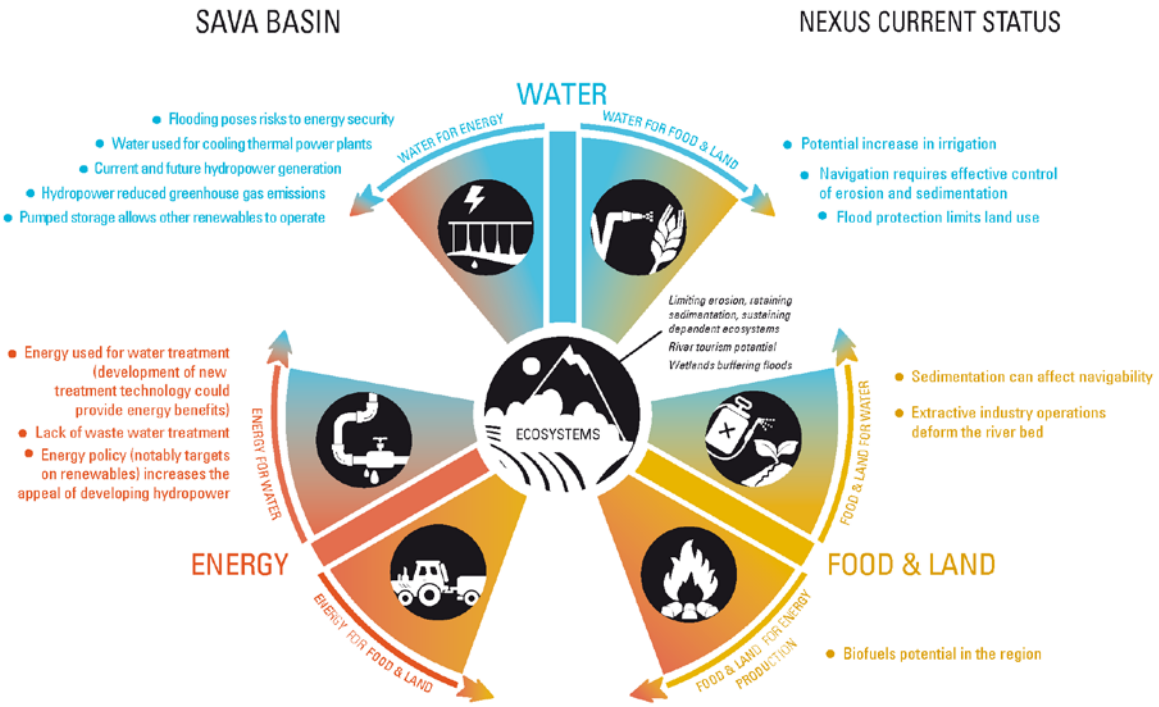
Figure 3. Key indicators describing the resources and socio-economics of the Sava countries



ANALYSING NEXUS LINKAGES

29. Energy, water and land resources as well as ecosystem services are closely linked in the Sava basin. Figure 4 provides an overview of the current status of the nexus linkages. In the Sava Basin, energy-water and water-land links are of particular importance.

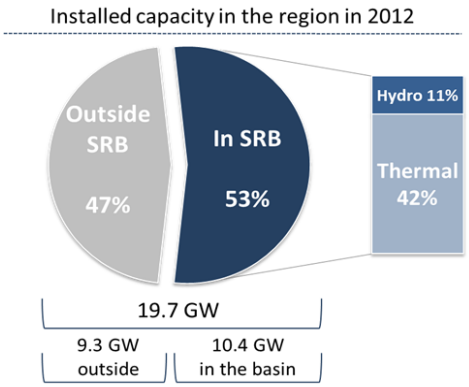
Figure 4. Nexus linkages in the Sava basin



- *Energy and Water*. Most of the region's electricity production takes place in the Sava basin (see Figure 5). The basin is home to 76% of the region's thermal power plants – which require water resources for cooling -- it is likely that future construction of thermal power plants will also take place in this basin. In addition, the Sava basin provides the largest proportion of the hydropower generation in the region -- by country this amounts to 15% in Slovenia, 5% in Croatia, 24% in Bosnia and Herzegovina, 31% in Serbia and 45% in Montenegro of national hydropower generation. The basin's large quantities of hydropower and flexible hydro-power potential can facilitate large penetration of solar and wind power plants in its riparian countries by providing "balancing services" (i.e. providing energy supply to compensate shortfalls from other energy sources). The energy sector in the Sava basin has proven vulnerable to the status of water resources -- in dry spells generation from hydropower plants has decreased, and during flooding instances, cooling systems have been

compromised, resulting in forced shut downs. Flooding has also affected operation of coal mines in Serbia. At the same time, energy is used for powering the water system, which includes water pumping, irrigation and treatment.

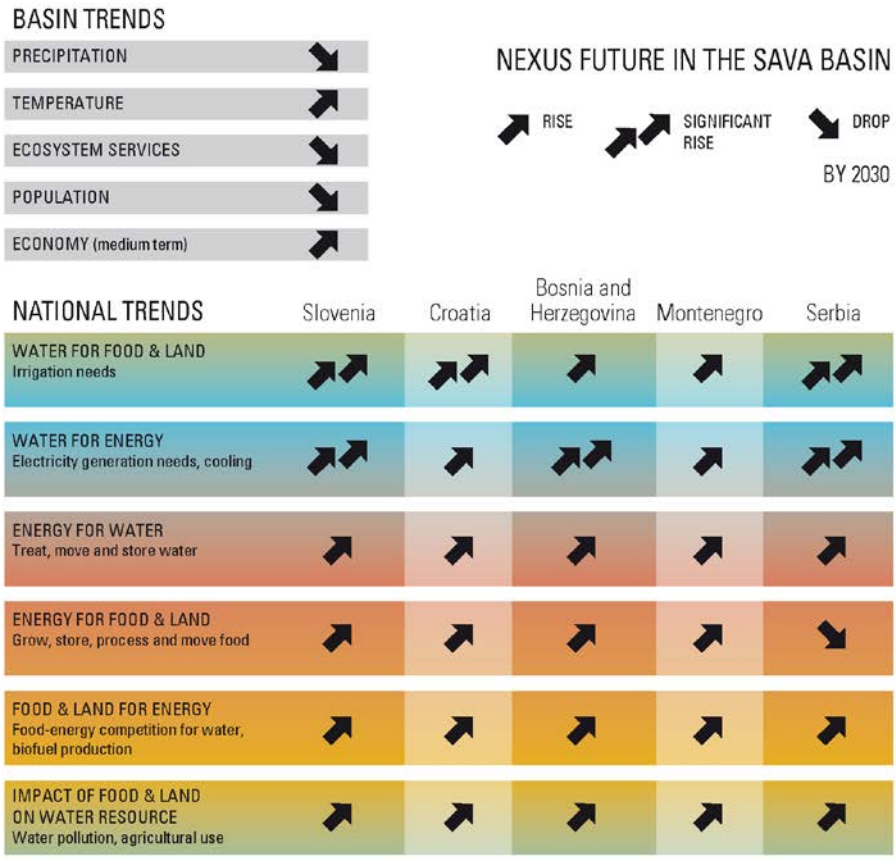
Figure 5. Role of hydropower in the energy mix in the Sava basin



- *Water and Land***.** Both built and natural infrastructure provide important flood control services. Maintaining, managing and valuing such services is key to reduce the potentially devastating socio-economic impacts of flood events. Sound land use management and gradually improving flood risk management with the implementation of the EU Floods Directive and the Protocol on Flood Protection to the FASRB are expected to improve the situation. Lower impact floods, which often last for up to four days, can be better contained if natural floodplains are complemented by spare reservoir capacity, and a centennial flood (with levels of about 6000 m^3/s) hitting the Sava River Basin could be delayed by at least four hours if current water storage infrastructure (with a capacity of 1,752 km^3) are half full. Erosion and sedimentation affect different sectors, notably navigation. The recently completed sediment mass balance study and the Protocol on Sediment Management to FASRB provide a good basis for developing concerted actions, including regulation of sediment extraction from the river bed.

30. The links between land, water and energy resources will intensify in the future. Socio-economic developments will drive a more intense use of resources in the Sava Basin. Pressures on land, water and energy resources will increase for all countries. However, not all basin's resources will be affected in the same way. Water resources in particular will experience heavier impacts both from linkages to energy and land resources (see Figure 6). Indirect effects need also to be considered --for example, an expansion in the agro-industry will necessarily result in an increase in irrigation requirements, in turn that will result in energy demand.

Figure 6. Future trends among nexus linkages in the Sava Basin



31. Looking at the future, the links between hydropower generation and agricultural production are of particular importance in the Sava basin. As discussed earlier, economic development will drive the expansion of energy generation and agricultural production. The future implications depend, among other factors, on actions taken to limit impacts on the environment. Hydropower is under pressure to be exploited to a larger extent in the region due to its low cost, being a 'domestic resource', increasing demand and its greenhouse gas reduction potential[10]. Both hydropower development and agricultural development are heavily dependent on water resources, which will be affected by climate change as well as by land use change.

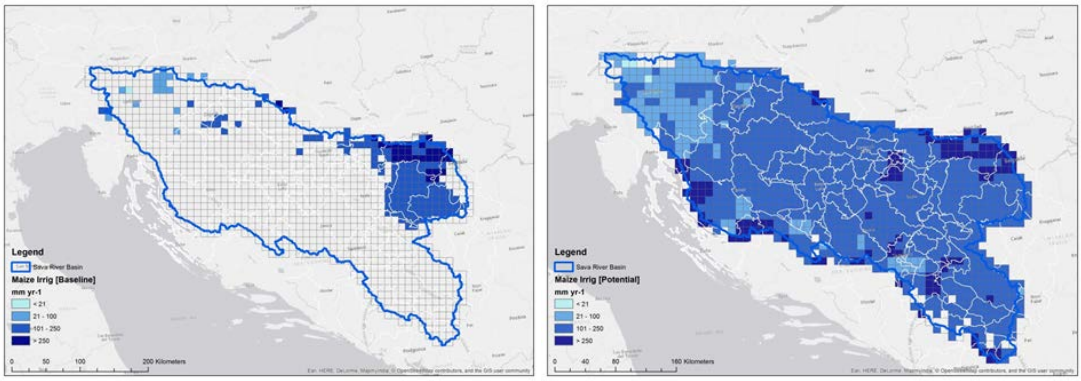
32. The results of the analysis of the combined effects of hydropower and agricultural expansion are summarised in Figure 8. The figure's north-west quadrant shows a map of the impacts of hydropower development. Future hydropower expansion was modelled assuming that the energy sector minimises the generation costs of the energy mix and typical business as usual expectations. Hydropower expansion was modelled under two scenarios were developed. The first scenario assumes a drier climate (i.e. lower rainfall) according to the Intergovernmental Panel on Climate

[10] The actual hydropower generation capacity in the Sava Basin is 2,188 (MW), while some 3,358 (MW) is planned. For the various sources, please refer to table 2 in document ECE/MP.WAT/WG.1/2015/11.

Change (IPCC) projection RCP45[11]. The second scenario adds to the first scenario the cumulative effect of agricultural expansion (which generates an increase in water demand for agricultural uses). The detailed integrated hydrological model LISFLOOD with embedded irrigation requirements was used by JRC to calculate the water availability for hydropower as a consequence of increased irrigation and climatic changes effects of the figure's north-east quadrant shows the generation mix under the baseline scenario. The changes in electricity generation mixes under the two scenarios have knock-on effects on energy trade (net electricity imports) as well as greenhouse gas emissions (emissions of carbon dioxide, CO_2). The two graphs in the bottom of the figure show the results for Bosnia and Herzegovina. The south-west quadrant shows the changes in energy trade levels: as water is diverted for crop production, the amount of electricity imported also increases. Under the second scenario, agriculture expansion exacerbates the increased irrigation needs prompted by lower rainfall. As shown on south-east quadrant, greenhouse gas emissions trajectories change as well -- lower hydropower production results in higher emissions for both scenarios.

33. The European Commission's DG Joint Research Centre contributed to the Sava Nexus study with a detailed hydro-economic modelling, taking into account hydropower facilities and irrigation demands amongst others (LISFLOOD), in combination with a detailed crop growth model (EPIC) launched. For the Sava it was found that the current average maize yield of 5.7 tons/ha/year could be increased to 9.9 tons/ha/year - a 74% increase – if maize would be optimally irrigated everywhere in the Sava. This would however have a substantial additional water demand (see figure), of around 200-300 mm for the newly irrigated areas.

Figure 7. Annual Water Demand for current (left) and the optimum maize irrigation scenario (source: JRC 2014)



34. This additional water abstractions would then have implications for water available for hydropower and cooling thermal power stations. In addition, the JRC modelling shows that substantial increase in lowflow conditions would arise in the lower Sava – having consequences for navigation, environment, drinking water intake, and further downstream Danube water availability – as well as leading to unsustainable groundwater resources use in the lower Sava region.

[11] Representative Concentration Pathways (RCPs) are consistent sets of projections about radiation serving as input for climate modelling.

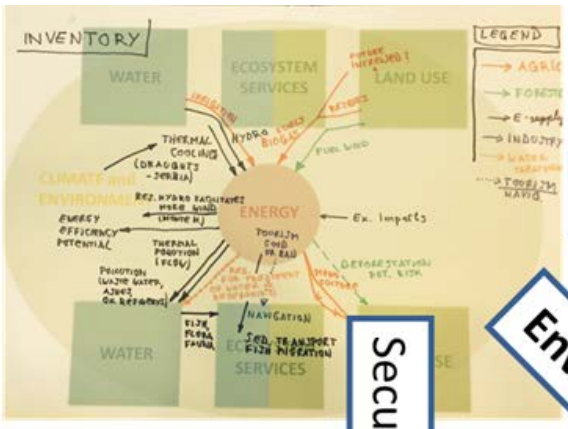
Additional climate simulations are still ongoing to evaluate additional effects due to climate change.[12]

35. This analysis highlighted the benefits of efficient irrigation. As agriculture expands more groundwater is pumped for irrigation, which causes an increase in energy use for pumping -- due to both increased quantity of water to be extracted and to the increased depth from which water has to be pumped. Moving to efficient irrigation would reduce the total volume of water that needs to be pumped, thus reducing energy demand. Reductions in water used lead to other effects -- such as reduced water logging and salinization. In dry years, electricity production costs increase due to lower hydropower generation -- which needs to be compensated by generating additional power generated in thermal power plants and increasing electricity imports from nearby countries (with energy systems that will likely be facing similar pressures). These are the years when irrigation levels will increase, and when the cost of irrigation will increase (due to higher energy costs and the need to pump water from deeper levels). Thus, increased water efficiency in irrigation has the benefit of reducing water consumption, with a more pronounced effect when water is scarcest.

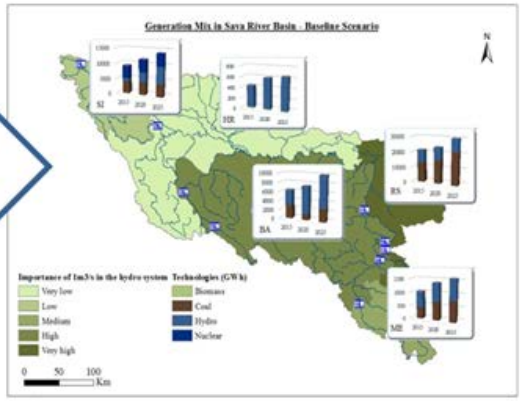
36. The analysis also highlighted the need for aligning timescales of energy and water planning. Energy planning (including the assessment of energy expansion needs, the setting of renewable energy targets, the definition of energy efficiency policies, and other energy planning aspects) usually takes a multi-decadal perspective. This is also the case for climate policies – when projecting greenhouse gas emissions trajectories, and developing mitigation and adaptation strategies. However, water planning (driven by the implementation schedule of the EU Water Framework Directive) mostly follows a six-year cycle. As a consequence, long-term energy planning does not take into account water constraints, potentially putting long-term investments and policy targets at risk.

Figure 8. Trade-offs and impacts related to hydropower production.

[12] These results from JRC will be available in a separate report later in 2015.



Value



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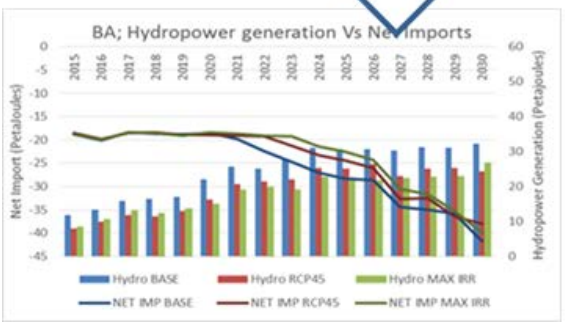
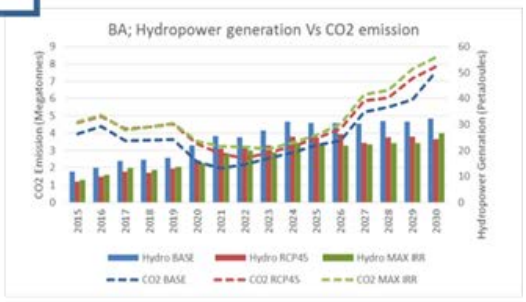




EXPLORING SOLUTIONS

37. In response to the intersectoral challenges described earlier, several types of responses can be helpful.

38. **Institutions.** While the Sava Basin already has a relatively well-developed governance architecture, it is not yet sufficient to fully apply a nexus approach. Options to strengthen it include:

- *Clarifying roles and responsibilities* – two important areas are (i) monitoring of basin resources and (ii) supporting the application of sustainable development principles in economic and sectoral planning and decision-making
- *Developing a consultation process* to review the impacts of national and sectoral development strategies on basin resources – for basin-level impacts this could be done through the International Sava River Basin Commission
- *Reviewing the mandate* of the International Sava River Basin Commission, which already serves as a platform for navigation and water management issues to be able to discuss (and eventually act) regarding all relevant basin resources[13]

39. **Information.** The implementation of a nexus approach to managing the Sava Basin's resources requires better information to improve national-level inter-sectoral coordination and the development of a shared knowledge base for transboundary cooperation. Options include:

- *Monitoring* of basin resources (groundwater, surface waters, biodiversity, soil) both in terms onf quantity and quality, and with particular attention to some degradation processes (e.g. erosion and sedimentation)
- *Forecasting,* in particular of water-related hazards (floods and droughts) in order to reduce related risks.
- *Information sharing,* for example through further development of the International Sava River Basin Commission database[14].

40. **Instruments**. There is scope for a more systematic use of policy instruments to address the trade-offs and exploit the synergies offered by a nexus approach to managing the Sava basin's resources. A mix of policy instruments will be needed to exploit the high potential in the basin to increase resource efficiency – for example to promote the use of low flow appliances in households and the adoption of more efficient irrigation practices. Options include:

- *Regulatory instruments*, such as
    - Transboundary Environmental Impact Assessment (for projects)
    - Strategic Environmental Assessment (for plans and programmes)
    - Minimum environmental flows (regulated by law)

[13] The Parties to the FASRB are considering amendments to FASRB introducing the legally binding character of the ISRBC decisions to certain fields of water management. This is already the nature of ISRBC of decisions related to navigation.

[14] Establishment of the core Sava geographical information system (GIS) functionalities and completion of the Sava hydrological information system will improve sharing of information.

- *Economic instruments,* which can serve both to provide behaviour-altering incentives (positive or negative) and to raise funds.
- *Information intruments,* in particular guidance and training of productive agents (such as farmers), but also including awareness of users and consumers (for example regarding water and energy use).

Box 2. Use of Strategic Environmental Assessment in the Sava countries

Strategic Environmental Assessment (SEA) is an instrument with great potential for resolving conflicting demands on water usage and can be used for policy-level assessments with multi-sectoral impacts, for example in order to conduct assessments with relevance to the Habitats Directive. While laws on EIA and SEA have been introduced at the framework level throughout the region, in some riparian countries implementation is not complete and practice is not well developed. Only 70 EIAs had been conducted in Republika Srpska by 2010, for example, mostly related to extractive industries and energy production. The applicability of strategic environmental assessment, or SEA, of public plans and programmes is less uniform throughout the region. The EU SEA Directive 2001/42/EC has been transposed into the legislation of Member States Slovenia and Croatia, while harmonization of legislation is advanced in Serbia but not beyond an initial stage in Bosnia and Herzegovina. Most transboundary SEAs conducted in the region are related to water management and energy.

41. **Infrastructure.** The sustainable management of the Sava Basin's resoures will require larger but also smarter investment in infrastructure as well as consultation of different related interests and assessment of impacts. For example, multi-functional reservoirs and synchronised reservoir control can provide a buffer, strategic releases and flow control. There is also unquantified but important potential for natural infrastructure. Options include:

- *Promoting multiple and flexible use of infrastructure* – in particular dams, irrigation and drainage systems
- *Investing in expanding and upgrading water infrastructure* – such as wastewater treatment.
- *Coordinating infrastructure investments* – such as in hydropower and other renewable energy sources
- *Protecting natural infrastructure assets* – such as floodplains and wetlands

42. **International coordination and cooperation.** While a large part of the agenda detailed above can rely on national-level actions, international coordination and cooperation at basin and regional level offers additional opportunities to "manage the nexus". Examples include:

- *Legal instruments* – in particular the FASRB and its protocols (Protocol on Flood Protection, Protocol on Sediment Management, Protocol on Prevention of Water Pollution caused by Navigation, Protocol on Emergency Situations) but also including the EU Directives (Water Framework Directive, Flood Directive)

- *Guidelines*. Examples include (i) the Guiding Principles for Development of Inland Navigation and Environmental Protection in the Danube River Basin; (ii) the Guidelines for Sustainable Development of Hydropower in the Danube River Basin, and (iii) Eco-tourism Development Guidelines for the Sava River Basin. With the various guidelines available, emphasis should be on applying the principles and putting them into practice.
- *Planning processes* – such as the Sava River Basin Management Plan (to coordinate action between different water using sectors, energy and agricultural sectors) and the Flood Risk Management Plan for the Sava River Basin (to coordinate action around flood retention areas and wetlands)

Box 3. Funding infrastructure solutions in the Sava countries

For funding the necessary infrastructure upgrades and extensions, various possible actions have been highlighted to the Sava riparian countries, for example by UNECE in the Environmental Performance Reviews:

- ensuring the financial viability of utility companies and internalising externalities by gradually raising the tariffs to levels that allow for a full cost recovery and reflect the real supply costs and increasing bill collection rates (Montenegro, Serbia);
- regionalising communal utility services to exploit the scope for public-private partnerships in the provision of services (Montenegro);
- introduce individual metering of water consumption (Serbia);
- establishment of autonomous institutions operating on a financially sustainable basis and of an independent body to regulate prices and benchmark utility performance (Slovenia)
- introduce secondary legislation with an unambiguous fee structure and initiate collection of all fees and charges instituted by it (Bosnia and Herzegovina).

IDENTIFYING THE BENEFITS OF ADOPTING A NEXUS APPROACH

43. By adopting a nexus approach to the management of the Sava basin's resources, Sava countries can exploit many potential benefits. The results of a rapid scoping of those benefits is summarised in Table 1. Table 1 follows the analytical framework for analysing the benefits of transboundary water cooperation developed according to the UNECE's policy guidance note on identifying, assessing and communicating the benefits of transboundary water cooperation.[15]

44. All the benefits of adopting a nexus approach to the management of basin resources are ultimately enjoyed by individual countries. In some cases, the benefits are only enjoyed by the country that takes action. In many cases, however, the actions of one country generate benefits in other countries (transboundary dimension). When potential individual solutions are evaluated ex-ante, it may be possible to identify and to some extent assess which benefits are enjoyed nationally and which ones are enjoyed by other countries. However, considering the aggregated benefits of a package of potential measures would justify more ambitious action than would be the case if each measure is evaluated only individually.

Table 1. The benefits of transboundary cooperation on the nexus issues in the management of the Sava basin's resources

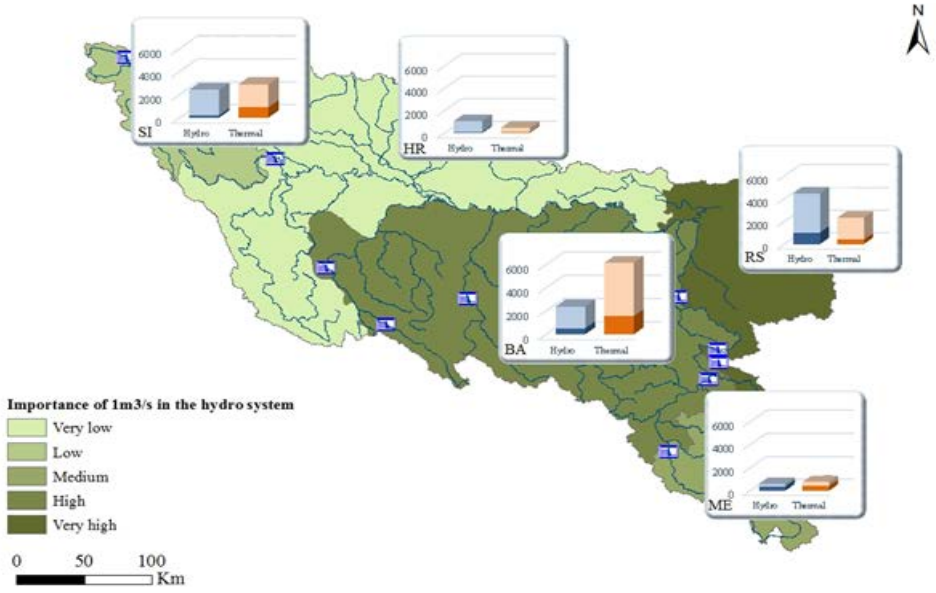
	On economic activities	**Beyond economic activities**
From improved management of basin resources	**Economic benefits** • Increased viability of economic activities relying on basin resources • Development of agricultural sector and its value added • Development of sustainable river tourism • Reduced economic costs of water-related hazards (floods and droughts) • Reduction of transport costs or increased volume of traffic (thanks to increased capacity and use of better maintained waterways) • Reduction of energy costs (thanks to optimisation of potential energy sources) • Reduction of water infrastructure costs (thanks to avoidance of duplication and sub-optimal location)	**Social and environmental benefits** • Employment creation (e.g. in agriculture and tourism sectors) • Reduced human costs of water-related hazards (e.g. floods) • Health benefits from improved water quality • Improved water services for users • Improved recreational opportunities from improved water quality and healthier ecosystems
From increased trust among Sava countries	**Regional economic cooperation benefits** • Increased trade through waterways • Development of regional markets for goods, services and labour	**Geo-political benefits** • Improved likelihood of complying with EU requirements and regional targets (e.g. regarding status of

[15] Document ECE/MP.WAT/WG.1/2015/4 contains a draft of the policy guidance, which will be reviewed by the Working Group on Integrated Water Resources Management at its tenth meeting. The document is available from http://www.unece.org/env/water/10th_wgiwrm_2015.html#/.

	• Increased cross-border investments	waters, renewable energy targets and agricultural policy)

45. Adopting a nexus approach under transboundary cooperation would allow maximising the potential benefits provided by the basin's resources. For example, it would allow using water in the sector and location where it provides the highest value. The value of water varies across the basin. Figure 8 shows how "upstream water" has a high value as it can pass through more hydropower plants. As a consequence, from an overall systems perspective, investments in irrigation efficiency become economically attractive also in upstream parts of the river basin even if conditions for agriculture are more favourable downstream.

Figure 8. Indicative value of water use for hydropower and planned power plant expansions in the Sava Basin



CONCLUSIONS AND RECOMMENDATIONS

46. **The Sava Basin's resources play a key role in the development in each riparian country**. As it has been discussed above, energy, water, land and environmental resources in the Sava Basin contribute to economic development and employment generation, and they have the potential to increase that contribution to developments in resource-based sectors such as agriculture/agro-industry and tourism.

47. **The basin's resources are under increasing pressures**. Growing demand for energy is driving the expansion of energy system investments, which are closely linked with water availability. Growing water demands from several sectors often go together with decreasing water availability under climate change. Land use changes driven by socio-economic factors and climate change will exacerbate the impact of flood risks and water scarcity.

48. **Most links between countries and sectors in the basin take place through water resources.** The Sava Basin's water resources are central to electricity development in the region -- by 2030 approximately 30% of new thermal power plants and 19% of new hydropower plants of all riparian countries are expected to rely on the water resources of the Sava Basin. Flood control will continue to be important to avoid power generation failures due to malfunctioning of thermal cooling systems – especially as new power plants are built in downstream countries. The impacts of climate change will be felt in the energy and agricultural sectors through changes in the availability of water resources. Controlling erosion and sedimentation would benefit agriculture, land management, extractive industries, navigation and water resources. Water resources need to be managed to meet direct and indirect (nexus) needs at all times – including through minimum flow requirements.

49. **From the perspective of hydropower generation, water upstream is of higher cumulative value than water downstream** as it can be used for hydropower generation in more power plants than water further downstream. The notion of water value across the basin can inform the prioritisation of actions.

50. **The trade-off between hydropower development and agricultural expansion needs to be carefully managed**. Hydropower investments in the Sava Basin are key to achieving climate change mitigation targets in the region (by 2030, 43% of carbon dioxide reductions in the riparian countries is expected to come from hydropower investments) as well as to national renewable energy targets (between 10-36% of depending on the country). The modelling results suggest that significant crop yield increases could be obtained by optimising irrigation. However, increased irrigation might have substantial effects to surface water and groundwater flow, especially in the lower Sava Basin during dry periods. Expected higher levels of irrigation would reduce water availability for hydropower generation some of the tributaries —increasing energy costs and greenhouse gas emissions.

51. **The strong demand for hydropower provides the opportunity to invest in multi-functional infrastructure or to adopt designs that minimise impact on the environment.** Approximately 200 MW of hydropower generation will be built in the region with reservoirs. These reservoirs may help serve as flood control, maintaining appropriate navigation depths and rationalising investments and maximising the utility to be had from the water. Irrigation and drainage systems' development could be done taking into account effects on flood response.

52. **Responding to the challenges and seizing the opportunities requires stronger multi-sector and transboundary planning**. Measures addressing single challenges in individual sectors a single cannot be taken any longer in isolation. They need to be evaluated in a multi-sectorial environment in order to recognise and manage the trade-offs – for example, building hydropower dams for energy targets and dykes for flood protection might conflict with EU Water Framework Directive aims such as hydro-morphology and ecological status. The linkages between sectors and countries, as well as the broader social and economic impacts, need to be recognised and better understood in order to prioritise actions in the different countries and sectors. Planning across sectors needs to be better aligned in terms of timescales – currently, the energy sector is defining investment plans with decades of anticipation while river basin management plans have six-year horizons. Consultation on national and sectoral development strategies through ISRBC, taking into account basin-level impacts, would be beneficial to that end. At the same time, differences in governance frameworks for different sectors or uses need to be acknowledged and taken into account.

53. Preparation of River Basin Management Plans supports **valuable engagement with a broad range of stakeholders at the transboundary level but improving coordination with energy and agriculture sectors would be an important reinforcement** to its scope. The strategic environmental assessment (SEA) is an effective tool to assess the impact of energy, water management and agricultural programmes and policies on ecosystems and to synchronize competing objectives, as well as to ensure proper public participation.

54. **The Sava Basin already has in place a multi-sectoral platform for transboundary cooperation.** The International Sava River Basin Commission allows for different interests to be heard when issues of concern related to use and protection of water resources are being discussed. It facilitates the harmonization of approaches, application of jointly developed guidelines and principles – for sustainable hydropower, navigation and environmental protection. EU policies and processes represent both a driver and an opportunity to improve management of the nexus – for example the EU initiative to improve resource efficiency beyond sectoral mandates.

55. **More intense transboundary cooperation on the management of basin resources will bring additional real benefits**. This does not apply just to transboundary water cooperation. For example, the different energy generation and storage capacities make up valuable complementarities which can add to the energy security for all the riparian countries.

56. **Ultimately, stronger and more coherent national policies, based on reliable information covering different sectors, are needed to "manage the nexus".** They are needed, for example, to resolve existing water allocation conflicts. Multi-sectoral assessment processes, such as Strategic Environmental Assessment including, can support the development of more coherent national policies. Development of broad, open, transparent and efficient platforms for reliable, high-quality data to serve as the foundation for high-quality decision-making merits focused efforts. Supporting and up-grading the currently uneven monitoring capacities would improve inputs.

57. **This pilot Nexus Assessment only provides an overview of the importance of the basin's resources, the inter-sectoral linkages, potential solutions and untapped benefits.** Further analytical, stakeholder engagement and planning work will be needed to identify precise governance reforms, policy measures and investment opportunities to address the challenges and seize the opportunities.