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Report

Navigating through deep waters of uncertainty

Systems analysis approach to strategic planning of water resources and water infrastructure under high uncertainties and conflicting interests

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NORWEGIAN MINISTRY OF FOREIGN AFFAIRS

GREEN ACTION TASK FORCE

OECD BETTER POLICIES FOR BETTER LIVES

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The research project 'Providing a training for EaP officers in strategic planning of water resources and water infrastructure in the context of conflicting stakeholder interests, high risks and uncertainty, using a participatory approach' (SRM number 500072163) was co-sponsored by the Government of Norway and the Organization for Economic Co-operation and Development (OECD)

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This paper is based on the outcomes of the project "*Providing a training for EU Eastern Partnership officers in strategic planning of water resources and water infrastructure in the context of conflicting stakeholder interests, high risks and uncertainty, using a participatory approach*" delivered by the International Institute for Applied Systems Analysis (IIASA) in July-December 2018 under a contract and in partnership with the Organisation for Economic Co-operation and Development (OECD) with financial support from the Government of Norway. This support is gratefully acknowledged.

The International Institute for Applied Systems Analysis (IIASA) is an international research organization located in Laxenburg, near Vienna, Austria established in 1972 by the Soviet Union, United States, and ten other countries from the Eastern and Western blocs. Currently the institute has 22 member countries. IIASA's current mission is "to provide insights and guidance to policymakers worldwide by finding solutions to global and universal problems through applied systems analysis in order to improve human and social wellbeing and to protect the environment". It fulfils this mission by conducting interdisciplinary research on environmental, economic, technological and social issues in the context of human dimensions of global change and sustainability. Because these issues are global in nature, the responses, even if implemented locally, have to be globally consistent and systemic.

The OECD is a unique forum where governments work together to address the economic, social and environmental challenges of globalisation. The mission of the OECD is to promote policies that will improve the economic and social wellbeing of people around the world, and its present mission statement is: "*better policies for better lives*" (for more details visit www.oecd.org). *Inter alia*, the OECD is committed to improving the ways to tackle existing and emerging global challenges. This requires enhancing the scientific basis of policy to better understand the complexity of the economy and its interactions with other complex systems, such as society and the environment, and building resilience to shocks. For more than 20 years, the OECD has been supporting the countries of Eastern Europe, the Caucasus and Central Asia (EECCA) to green their economies. This work is delivered through the GREEN Action Task Force (former EAP Task Force) with the mission to "guide improvement of environmental policies in transition economies of Eastern Europe, Caucasus, and Central Asia (EECCA) by promoting the integration of environmental considerations into the processes of economic, social and political reform".

IIASA and the OECD have a long history of mutual collaboration. A strategic partnership between the two organisations was established in 2017 and is supported by the subsequent formation of the OECD-IIASA Task Force on Systems Thinking, Anticipation and Resilience. The taskforce is committed to combining the policy and action expertise of the OECD with the scientific and analytical excellence of IIASA to jointly shape, develop and implement innovative approaches based on applying systems thinking to the critical global issues facing humanity.

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Abbreviations

EAP	Environmental Action Programme
EECCA	Eastern Europe, the Caucasus and Central Asia
EUWI+	*European Union Water Initiative Plus for Eastern Partnership countries* (an EU-funded project)
IIASA	International Institute for Applied Systems Analysis
IWRM	Integrated Water Resource Management
MCDA	Multi-Criteria Decision Analysis
NPD	National Policy Dialogue
NSSD	National Strategy for Sustainable Development
OECD	Organisation for Economic Co-operation and Development
RPG	Role-playing gaming
SDG	Sustainable Development Goals
UNECE	United Nations Economic Commission for Europe
WSS	Water Supply and Sanitation

Navigating through deep waters of uncertainty

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Introduction

Water is a truly cross-sectorial and transboundary resource: it is used by several sectors from energy to agriculture within a country, and oftentimes countries share water basins. The availability and quality of water has a great impact on population well-being, economic growth, and environment. Developing and implementing robust ("no-regret") water policies is of high importance for a sustainable development of any country. Feasible policies should reconcile conflicting interests of different sectors and different stakeholders as well as they should take a proper account of immense uncertainty about the future availability of water resources and key factors, which impact it.

IIASA, in partnership with OECD, developed and made available for potential users a gamified participatory approach to strategic planning aimed at devising such robust water strategies by eliciting collective wisdom of relevant experts and stakeholders. The approach builds on a fusion of a number of qualitative systems analysis methods, including multi-criteria decision analysis, systems mapping, morphological analysis, scenario building, and robust decision-making. It enables a group of stakeholders and experts to collectively produce a set of agreed strategic objectives, analyse enabling factors, which allow to achieve these objectives, understand key uncertainties involved in the underlying processes and derive robust policies.

The approach was successfully pilot tested through a project titled "*Providing a training for EU Eastern Partnership officers in strategic planning of water resources and water infrastructure in the context of conflicting stakeholder interests, high risks and uncertainty, using a participatory approach*" implemented by IIASA in July-December 2018 under a contract, and in partnership, with the OECD with financial support from the Government of Norway. This paper presents in some detail the developed participatory strategic planning approach and how it was used for implementing the aforesaid project.

When deciding on the project scope and selection of trainees, an important objective was to the extent possible explore synergies with ongoing work on water by the partners: for instance, the OECD GREEN Action Task Force was engaged in the European Union Water Initiative plus (EUWI+) programme funded by the EU and implemented in the Eastern Partnership countries of Azerbaijan, Armenia, Belarus, Georgia, Republic of Moldova and Ukraine. Under the EUWI+, several beneficiary countries requested support to developing or updating national water strategies or mid-term plans and respective work supported by a capacity development component was included in the EUWI+ Work Plan and a training workshop on conventional strategic planning methodology was held in Minsk in April 2018.

To explore natural synergies with the EUWI+, under this project funded by the government of Norway we involved individuals representing relevant stakeholders from interested Eastern Partnership countries (Belarus, Georgia, Moldova and Ukraine) and ran a process implementing our innovative participatory strategic planning approach for an imaginary country. As a result, the participants/trainees, facilitated by IIASA researchers, worked out a prototype of a national water strategy of this imaginary country.

We designed this particular process to help participants to acquire a deeper understanding of the role of uncertainty in decision making, to enhance their experience in developing resilient water strategies and to raise their awareness about strategic planning methods taking into account the nexus of water with other sectors, notably, food and energy, as well as conflicting interests of various water uses and users.

This participatory strategic planning approach in the context of high uncertainty was used as a tool to support a sustainable water management in a country by recognising and operationalising systems thinking, which allows to reduce the risks of unintended consequences and optimises the use of water by multiple consumers. In this way, the project helped to strengthen the capacity of the participants in strategic planning, which was its primary purpose.

Complexity of strategic planning of water resources and water infrastructure management

Water is essential for life and has no full substitute. Worldwide water use has increased six-fold over the past century (Wada et al., 2016) and it continues to grow. Water use at the global scale is anticipated to further increase, as a function of the population size, economic growth and evolving consumption preferences, among other factors (WWAP, 2018). Global demand for water-intensive production such as agricultural and energy production is expected to grow by about 60% and 80% correspondingly by 2025 (Alexandratos & Bruinsma, 2012; OECD, 2012). At the same time, in many places in the world both surface- and groundwater availability is subject to scarcity and unequal geographical distribution in a variety of regions is increasing under the pressure of climate change, through changing precipitation amounts and variability.

Angel Gurría, OECD Secretary-General
24 April 2017
Putting water at the center of the global agenda

"Too little attention has been paid to water challenges, yet they are among the most significant threats facing humankind today. We have better evidence on the scale and nature of the problem than ever before, but we have not succeeded in building and sustaining the political momentum needed to deliver on our commitments as far as water is concerned."

In a range of areas, water quality is rapidly deteriorating bearing threats to ecosystems, population health and well-being, and sustainable development. Dangerous pollution is caused both by large volumes of untreated municipal and industrial wastewaters (point pollution) (WWAP, 2017) as well as by the overload of nutrients from agricultural activities (diffuse pollution) (UNEP, 2016). Increasing flood and drought risks and progressing ecosystems degradation pose further challenges for sustainable development of many regions in the world (Burek et al., 2016).

Water supply and sanitation (WSS) is a critical infrastructure, which is highly interconnected with other types of infrastructure and, being a public good, is essential for functioning of any society. Out of all utilities, WSS infrastructure is the costliest one in terms of capital costs per connected consumer; achieving WSS targets can take decades. Hence, long-term public interventions are required, and affordability constraints should be carefully assessed and addressed in a cost-effective way. Many parts of the national WSS infrastructure are natural monopolies requiring proper regulation.

Moreover, the water sector is in a tight connection with the other sectors of the economy, notably, food production and energy (so called Food-Water-Energy Nexus or, here, the Water Nexus). Water, food or energy insecurity has led to social tensions in many countries. Water is often at the centre: in many parts of the world, water shortage has been the main stress for food and energy industries, as well as for ecosystems. There is an increasing need to explore synergies and to address risks and trade-offs between competing uses of water while taking into account environmental and social considerations. Planning of critical sectors can no longer be done in isolation. If adequately addressed, this can bring productivity gains through a more efficient use of water and other resources, thus also contributing to greening of the economy. Equally, consequences of inaction could become increasingly severe threatening people's well-being, economic growth, jobs, and the environment (Burek et al., 2016).

The role of uncertainties in the context of Water Nexus has increased nowadays more than ever arising mainly from four directions: increasing climate and weather variability, rapidly changing economic development, shifting demographic patterns and evolving social norms and expectations (Cap-Net/UNDP, 2013). The interconnectedness of the Water Nexus system makes room for systemic risks; failures and disturbances in water infrastructure, which are caused by natural (extreme floods, droughts, mudflows, landslides, etc.) or man-made hazards, can result in cascading impacts on other critical infrastructures leading to an avalanche of severe consequences. The risk of failure and its impacts is multiplied by interdependencies among different sectors, a high number of involved stakeholders (e.g., water authorities on all management levels (national, regional, local), representatives of industries and agriculture, households, environmental organisations etc.), and conflicting preferences among them as well as by insufficient risk management and a lack of robust mitigation strategies.

Martin Lees, Chair of OECD - IIASA Task Force on Systems Thinking, Anticipation and Resilience

"We have to account for the issues of values, justness and participation. These are not technocratic questions when we talk about sustainability which can be resolved by modelling and technocratic decisions, they are human problems, first of all, and they raise questions of the equitable distribution of the costs and benefits."

Decision-makers have to make decent decisions even if the environment is dominated by high uncertainty while the stakeholder interests – domestic or transboundary – are conflicting. A typical example is a choice between the use of surface water in the summer time for irrigation versus storing it and using in winter for hydro-power generation under the condition of largely variable and unpredictable precipitation levels. Also, the traditional role of "governments" as the single decision-making authority has been replaced by multi-level, polycentric governance (OECD, 2015b). Because of these interconnections, local water management has global impacts, and global developments have local impacts (Wada et al., 2016). Hence, the process of addressing the Water Nexus issues is not linear and requires coordinated action on multiple levels.

Thus, a careful design of a comprehensive water strategy is required for a prosperous and sustainable development of any country. A water strategy at the national level typically covers both (i) water resources and aquatic ecosystem, and (ii) water infrastructure - for various uses. It should take into account the specificity and complexity of water resources, water infrastructure, and water management and should be based on transparent realistic assumptions and be supported by bold analysis. A water strategy should consider best international practices and proven principles and guidelines (e.g., the OECD Council Recommendation on Water (OECD, 2016), OECD Principles on Water Governance (OECD, 2015a); OECD Principles on Private Sector Participation (OECD, 2009); various UNECE Guidelines (UNECE, 2018b, 2018a), and include implementation tools.

In the light of the Food-Water-Energy Nexus, a water strategy should be coherent to and linked with other key policies, e.g., a National Strategy for Sustainable Development (NSSD) and sectorial policies, integrated into a broader macro-economic policy and budgetary frameworks. It should be adaptive and resilient to major risks and uncertainties manifesting on its designated timespan. A typical water strategy should cover and combine up to four different time horizons: (i) strategic time horizon: typically, 50-100 years, and more, (ii) mid-term time horizon: 7-30 years, (iii) short-term time horizon: 3-7 years, and (iv) workplans for immediate actions: 1-3 years.

The strategic importance of water, jointly with increased risks and uncertainties, calls for a water strategy to be ambitious but realistic not least from a financial point of view. Ultimately, a water strategy should address the following questions:

- Diagnosis of the present situation – what are the current state, trends, main challenges, key risks and uncertainties facing the water sector?
- Desirable future definition – what could be the strategic objectives and targets?
- Preferred and alternative scenarios – what are possible developments in the future? How do trends and uncertainties shape them? Which of the directions should be preferred to achieve the stated objectives?
- Interested stakeholders – who are the main stakeholders and what are their interests? How would different strategic choices impact key stakeholders? Which changes in the behaviour of key actors the anticipated strategy would require and how to ensure the desired change in behaviour (through which incentives)? Who would likely support the desirable changes, and who will resist to them?
- Implementation plan - what are critical strategic choices to make? Which trade-offs would they have? What are the strategic implementation constraints (e.g., financial feasibility, political acceptability, and technical *implementability*)?

To integrate these overlapping and contradicting aspects, a water strategy planning process should be supported by evidence-based analysis.

Systems thinking to assist strategic planning

Adaptation science for agriculture and natural resource (Meinke et al., 2009)

"Systems thinking places as much importance on understanding dynamic interactions between parts as it does on understanding the functions of the parts themselves. The system(s) of interest (and its/their outputs) need(s) to be viewed and evaluated holistically, including the key linkages and interactions between system components."

The current state of the world affairs calls for a revival of systems thinking to improve decision-making. Recognising that the tightening of socio-economic links heightens the need for holistic responses, that disciplinary and sectorial solutions are of limited effectiveness and efficiency, and that big data is not generating integrative perspectives by itself, highlights the need for policymakers to become thoroughly familiar with the promises and pitfalls of systems analysis. Challenges are systemic, dynamic, and interconnected, and systems analysis, coupled with an improved anticipation, provides a coherent methodology and necessary tools to develop new approaches so urgently required for more coherent and effective policy planning. Systems thinking can support social learning among stakeholders, i.e., learning among individuals and organizations to collectively manage issues in which they have a stake (Ridder, Mostert, & Wolters, 2005). It can also enhance the cohesion across conflicting stakeholder viewpoints by demonstrating how their knowledge is linked to the perceptions of others and with the entire system perspective.

Conventional methodologies for strategic planning have a limited power to be applied in situations of high risks and uncertainty complexified by conflicting interests of different powerful groups of stakeholders in a country. Innovative approaches should be used to develop a robust "no regret" water strategy. Systems thinking can help mitigate negative unintended consequences of decisions that are due to focusing on a single part of a system ignoring the effects of interdependencies. Systems analysis approaches could help to address "wicked problems" shaped by high uncertainties and complex causal patterns (Levy, Lubell, & McRoberts, 2018a).

IIASA has worked in the area of aiding decisions under uncertainty for many years in a number of projects and in 2018 was approached by the OECD with the suggestion to employ its methodologies for strategic planning in the water sector.

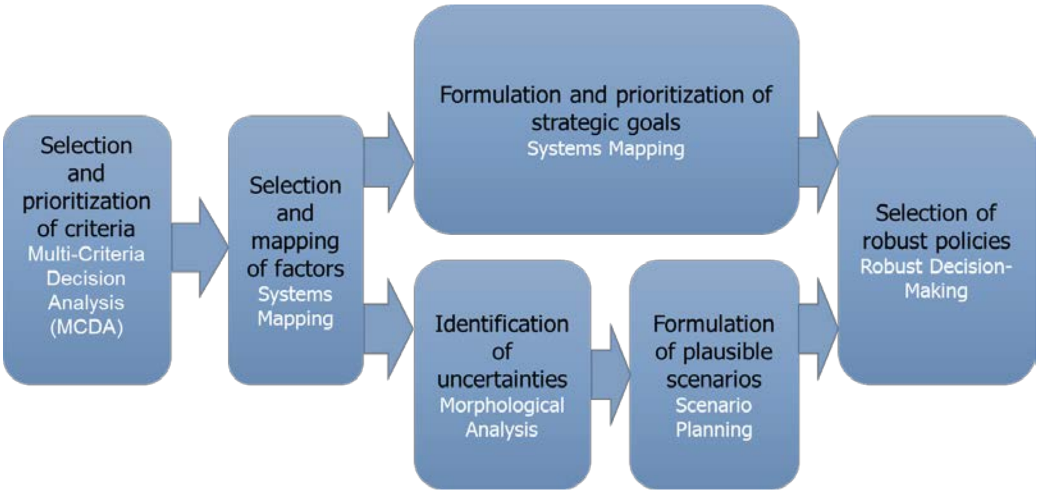
To address the policy-making complexity in the context of the Water Nexus, IIASA tailored a suite of systems analysis methods each tackling a specific strategic planning step (or, sometimes, multiple steps simultaneously) (Figure 1).

The designed suite consists of the following methods:

- **Multi-Criteria Decision Analysis (MCDA),** through a facilitated dialogue, enables to describe trade-offs and leverage priorities to identify most important criteria for various groups of stakeholders to be satisfied by the Water Strategy;
- **Systems Mapping** enables to reveal the most important factors and drivers of a national Water Nexus system helping to identify the objectives of the Water Strategy as well as the key uncertainties affecting the Water Nexus system;
- **Morphological Analysis** enables to explore possible alternatives of uncertainties;

- **Scenario Planning** enables to come up with narratives outlining plausible futures of the Water Nexus system on a specified time horizon;
- **Robust Decision-Making** enables to rectify a portfolio of policies and actions suitable across plausible scenarios and prioritize them according to their contribution to achieving strategic objectives.

Figure 1. A schematic representation of the systems analysis methods suite layout.



Source: authors' own elaboration

Note that these methods can be used independently to assist in addressing corresponding issues, or they can be used in a logical order as displayed on Figure 1 enabling a systematic guidance to the entire water strategic planning process. A more comprehensive description of the outlined methods is vailable in Appendix 1.

Participatory modelling as a catalyst of systems thinking

Stakeholder engagement and public participation in a water strategy planning process i s not only recommended (OECD, 2015b) or sometimes legally required (e.g., by EU Water Framework Directive (The European Parliament and the Council, 2000)), but also it makes the execution of the water strategy recommendations more straightforward reducing costs and time allocations and improving the ultimate outcomes (Ridder et al., 2005). The Integrated Water Resource Management (IWRM) framework stresses the need for participatory decision-making processes to be conducted, to the broadest possible extent including the local level. Therefore, capacity strengthening and awareness raising measures should be implemented at all planning levels to facilitate participation of all interested stakeholders (UNDP-SIWI Water Governance Facility, WIN, 2009). Several studies also highlight the importance of social learning for a successful water strategy implementation (Mostert, Craps, & Pahl-Wostl, 2008; Pahl-Wostl, Mostert, & Tabara, 2008).

Participatory modelling approach makes use of the knowledge of stakeholders about a certain policy issue and creates a shared formalized representation of the underlying system, i.e. a system's model. It is a process that allows one to take into consideration not only facts but also values by asking questions and collecting feedback from stakeholders (Forester, 1999). Therefore, it requires an active participation of stakeholders and a two-way communication, where feedback is collected, analysed and implemented into decision-support tools. This process is especially useful when facts are uncertain, values are in dispute, stakes are high, and decisions are urgent. A high level of participation is particularly helpful when different stakeholders are dependent on each other in reaching their objectives, but there is no agreement on a problem at stake (Ridder et al., 2005). The stakeholder interaction leads to an enhanced understanding of different points of view, criteria, preferences, and trade-offs involved in decision-making. Participatory modelling is also used to build compromises among groups of stakeholders on controversial or wicked policy issues and can be considered as an important part of the risk governance (Komendantova et al., 2014). Several studies highlight the potential of participatory modelling in developing capacity in systems thinking (Bell-Basca, Grotzer, Donis, & Shaw, 2000; Levy, Lubell, & McRoberts, 2018b), also in application to water (Singer et al., 2017).

> OECD Principles on Water Governance (OECD, 2015)
>
> ***Principle 4.*** *Adapt the level of capacity of responsible authorities to the complexity of water challenges to be met, and to the set of competencies required to carry out their duties, through:*
>
> *…*
>
> *e) promoting education and training of water professionals to strengthen the capacity of water institutions as well as stakeholders at large and to foster co-operation and knowledge-sharing*
>
> ***Principle 10****. Promote stakeholder engagement for informed and outcome-oriented contributions to water policy design and implementation, through:*
>
> *…*
>
> *d) Encouraging capacity development of relevant stakeholders as well as accurate, timely and reliable information, as appropriate*

The use of systems analysis to produce an ambitious yet realistic water strategy is even more powerful if executed in a collective, participatory setting. Thus, our suite of systems analysis methods (Figure 1) could be applied at its best in a strategic planning workshop involving stakeholders from different groups and levels. It is essential to ensure the participation of a balanced team of stakeholders, which is on one hand diverse enough, while on the other hand involving motivated and consensus-seeking individuals. The diversity of participating stakeholders and their perceptions of the problem can enrich the development and implementation of the strategy while science-based methods and decision-support tools provide enabling conditions for a compromise-building exercise (Page, 2007). All of the methods in our suite, either explicitly or implicitly, consider the plurality of opinions and are tailored for converging to a compromise. Notably, they imply an artful workshop facilitation by an experienced facilitator(s) who has no stake in the outcome of discussions, and is unbiased about the subject matter (Giovanni, 2007).

Illustrative case: Using systems analysis to support strategic planning of the water sector in EECCA and Eastern Partnership countries

In most countries of Eastern Europe, the Caucasus and Central Asia (EECCA), achieving water, energy and food security is among the key policy priorities. Some have included this objective in their National Development

Strategies and other policy documents. Some countries launched National Policy Dialogues (NPDs)[1] aimed at improving water resources management, including its trans-boundary dimension, with the ultimate objective to achieve water-related Sustainable Development Goals (SDGs).

The NPDs and other policy discussions in EECCA have so far focused on water, agri-food or energy sectors individually, and at best discussed water-energy and water-agriculture inter-linkages. These deliberations have identified a need for a more comprehensive discussion spanning across the three sectors (Water Nexus) with the support of modern quantitative and qualitative tools.

Since 2016, the UNECE, the OECD, the Austrian Environmental Agency and the International Office for Water (France) have been implementing the EU-funded *European Union Water Initiative Plus for the Eastern Partnership* (EUWI+) presented in the box below. Under the EUWI+, several beneficiary countries requested support to developing or updating national water strategies or mid-term plans and respective work supported by a capacity development component was included in the EUWI+ work plan.

EUWI+
EU WATER INITIATIVE
FOR EASTERN PARTNERSHIP

Box 1. The European Union Water Initiative Plus for the Eastern Partnership (EUWI+)

The European Union Water Initiative Plus for the Eastern Partnership (EUWI+) aims to assist the EU Eastern Partnership (EaP) countries – Armenia, Azerbaijan, Belarus, Georgia, Moldova, and Ukraine – to bring their legislation closer to the EU policy in the field of water management (EU water acquis), with a focus on the management of transboundary river basins. It supports the development and implementation of pilot river basin management plans, building on the improved policy framework and ensuring a strong participation of local stakeholders.

The work plan under the EUWI+ project envisaged local capacity development regarding strategic and mid-term planning of water resources and systems (infrastructure). This was demanded by several countries working on development or updating of their national water or water supply and sanitation (WSS) strategies. This demand was addressed through regional capacity development actions. A workshop on conventional strategic planning was held in the frame of the 5th International Water Forum in Minsk in 2017 and was attended by interested stakeholders from Belarus and delegates from other Eastern Europe, Caucasus and Central Asia (EECCA) countries. The second thematic event concerned conventional strategic planning methodologies and was held in Minsk, Belarus in April 2018.

Source: author's own elaboration

To complement the implementation of the EUWI+ work plan for capacity development in EaP countries regarding strategic and mid-term planning of water resources and systems, the OECD proposed an additional capacity development event on innovative methods and tools based on systems analysis and participatory

[1] https://www.unece.org/env/water/npd.html

approach, available for supporting the development of a resilient "no regret" water strategy in the context of conflicting stakeholder interests, inter-dependent drivers, high risks and uncertainty. This activity implemented in co-operation with IIASA and supported by the Government of Norway through the OECD GREEN Action Task Force helped explore synergies between respective actions by the EU and non-EU members of the Task Force.

Respective training workshop was co-organised by IIASA and OECD on 18-19 October 2018 at IIASA's premises. OECD and IIASA approached relevant ministries and agencies in all EaP countries with the invitation to nominate participants. Two participants from Belarus, two from Georgia and two from Ukraine, as well as one participant from Moldova, attended the workshop. The full list of participants is presented in Appendix 5.

Before the workshop, the invited participants were asked to familiarise themselves with some background information and to accomplish a set of tasks developed by the IIASA team to solicit inputs necessary to contextualise our methods. Namely, they had to provide their vision on the main factors (which are grouped for convenience in PESTEL[2] categories) important for the Water Nexus system, key objectives regarding water resources and infrastructure management and possible actions required to achieve these objectives (the details on the tasks are available in Appendix 3).

The two-day workshop consisted of five sessions, each covering a particular step towards a comprehensive water strategy one logically followed another (see Figure 1 above). Each session contained a theoretical introduction and an interactive process facilitated by IIASA researchers (Photos 1-4). The full workshop agenda is available in Appendix 5.

To avoid getting into local political complexities, to ensure a frank and open discussion on potentially sensitive issues and address different world views, while preserving the focus on real-life problems, which countries are facing, an enabling case-material on an imaginary country **Albagumia** developed by IIASA and OECD specialists exercise served as a "sandbox" object of the strategic planning exercise. A full description of Albagumia (so called "Legend") is available in Appendix 2. By design, it integrated typical features of, challenges and opportunities faced by, the beneficiary countries.

An ultimate outcome of the workshop was a robust water strategy for Albagumia. However, taking into account the fictiveness of the case study, the developed strategy itself should not be necessarily regarded as a guideline for real decision-making; though, it could nevertheless offer some food-for-thought for policy makers. A more tangible outcome in this particular exercise was the knowledge and experience gained by the participants regarding (i) the power of systems analysis methods and their applications to the strategic planning of the water sector, and (ii) a room for consensus in an uncertain environment given conflicting interests of the participating counterparts achieved through a facilitated participatory modelling process.

[2] According to the PESTEL classification, see e.g. http://blog.oxfordcollegeofmarketing.com/2016/06/30/pestel-analysis/

Photos 1-4. Interactive exercises at the strategic planning workshop

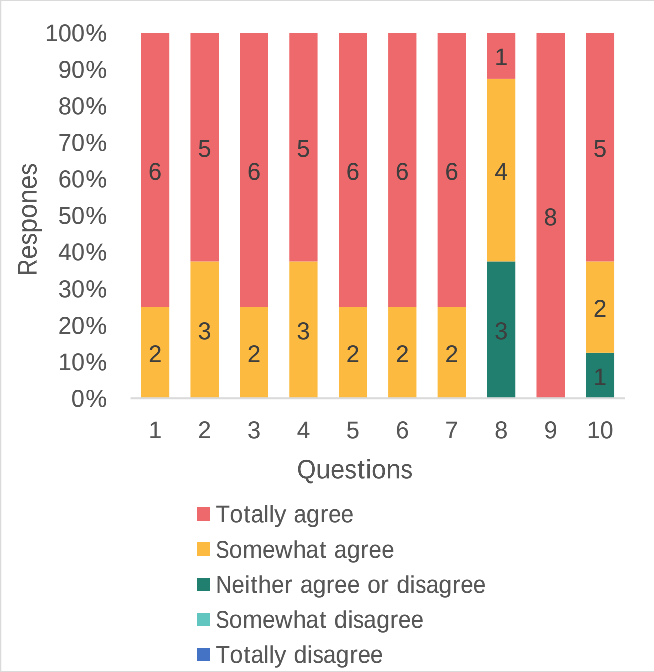
Source: authors' own photos

At the end of the workshop, the participants were asked to fill in the feedback forms. They assessed the workshop overall very positively. The statements with which the participants were asked to either agree or disagree below (Figures 2 and 3) covered both the workshop itself and the methods presented.

Questions about the workshop

1. I find the contents of the workshop helpful for my professional life.
2. The learning objectives were clear and plausible to me.
3. The structuring of the content was clear to me.
4. The workshop fulfilled my expectations.
5. I understood the contents and could follow the process
6. The workshop has encouraged me to contribute my own thoughts.
7. I was challenged to think.
8. My usual thought patterns were challenged.
9. In the workshop, there was an enabling environment for my contributions.
10. The training allowed me to grasp better and understand the complexity of policy planning.

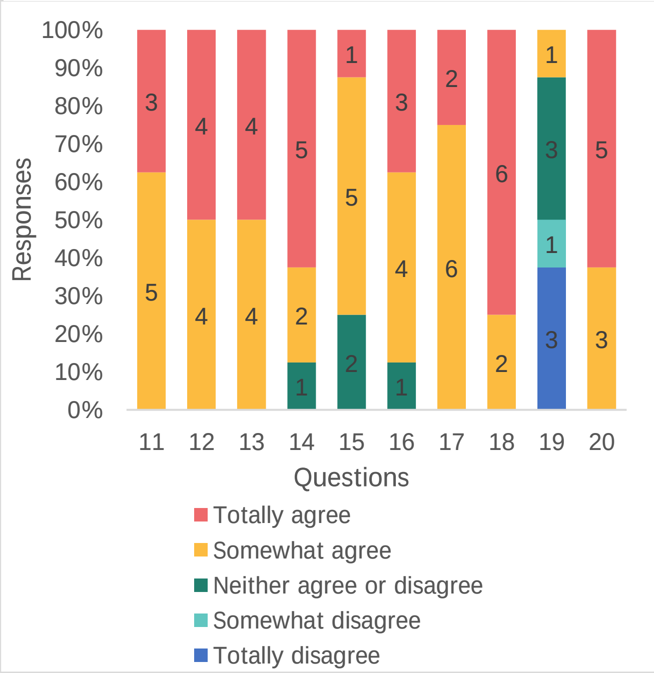
Figure 2. Summary of participants' feedback regarding the workshop process. Source: feedback from workshop



Questions about the methods

1. The presented process can inform and facilitate making responsible decisions.
2. I could see that national systems can develop in various unexpected ways.
3. In political decision-making, one is always confronted with uncertainty.
4. In political decision-making, one is always confronted with competing objectives and trade-offs.
5. If I, with some people from my organization, were to use such an approach to planning, all persons would be likely to follow the suggested process loyally
6. The modelling exercise has given me more insight into the importance of indirect connections and effects between the elements that compose the problem than I had before.
7. I can see connections between elements that are not intuitive at first.
8. The modelling exercise highlighted the diversity of opinions.
9. The modelling exercise using the system mapping approach has not given me insight into the possibilities of addressing the considered problem.
10. Using system modelling in approaching policy problems is efficient

Figure 3. Summary of participants' feedback regarding the presented methods. Source: feedback from workshop



Several participants also expressed their reflections on the workshop in the concluding discussion:

Participant from Ukraine: *These participatory methods are ideal to apply at a Basin Council. There are many stakeholders with various backgrounds representing different structures. The workshop setting could be used for finding a consensus.*

Participant from Georgia: *In Georgia, there are a lot of various strategic documents. There is often no justification for the goals and directions in these strategies. The described approach is useful for orientation. Using a synthetic case of imaginary country Albagumia is a good idea to avoid a political bias and be open and frank in presenting personal views.*

Participants from the Republic of Belarus*:*

- *The methods could be useful for backing up the choice of certain policy alternatives. However, there was no feedback for the strategy mentioned; it is important to monitor and adapt strategies deepening on the situation developments.*
- *I can call this a "method of a diplomat" as it enables finding a compromise. A methodological description (handbook) would be really useful, also in Russian.*

Participant from the Republic of Moldova: *<This> more scientific approach could be used to prove the necessity of certain policies. It is important to acquaint the local actors with these methods as well as donors <an example of the donor from Germany>. We could conduct a small pilot project, maybe on a regional level as the national level could be complicated. The workshop was really interesting for me and I will try to apply the methods I have learned. However, it could be a challenge to convince my colleagues.*

Conclusions and recommendations

On methodology

Strategic planning of water resources and water infrastructure involves immense uncertainties and risks of different nature along with conflicting interests of multiple stakeholders. Application of systems thinking to addressing this problem is an effective way to deal with these complexities. It is especially useful in a participatory setting enabling involved stakeholders to achieve a common understanding of the system's boundaries and constituting components, and behaviour, and agree upon common objectives and ways to mitigate possible risks. Application of specially tailored systems analysis methods as well as professional facilitation of the participatory process can significantly improve the quality of its outcome, i.e., the robustness of the designed water strategy. A resulting document produced by the participatory process could be a background paper with strategic analysis and a summary of key findings to inform the national water strategy. Decision-makers should ideally produce this paper after consultations with the other key stakeholders through a policy dialogue (Burek et al., 2016).

A robust water strategy is an immediate outcome of the participatory process. In the longer run, regular application of systems thinking concepts and methods may improve overall management capacities through the acquisition of the new skills, knowledge, and insights, building trust and improving relations between the stakeholders (Ridder et al., 2005). Participants of such process develop their systems thinking capacity, which is beneficial for further strategic planning activities, e.g., the design of an action plan related to the implementation of the developed water strategy. The participatory strategic planning process based on systems analysis we propose enables the participants to:

- Internalise a systemic nature of the problem of strategic planning of water resources and water infrastructure;
- Recognize the plurality of stakeholders and reconcile the diversion of their perceptions and objectives;
- Assess and explicate a broad spectrum of uncertainties and risks involved;
- Realize the multiplicity of the future development options which lead to multiple scenarios;
- Understand that various solutions have different effectiveness across multiple objectives in different scenarios and for defining a successful strategy one needs robust solutions and multi-criteria analysis.

The proposed participatory setting could be enriched by adding a role-playing gaming (RPG) component to the workshop process. RPG helps to concentrate on individually and separately known problems, forcing players to collectively acknowledge problems they face and making constructive discussions easier by leaving aside private considerations (Ridder et al., 2005). The designed imaginary country Albagumia description used for illustration at the workshop with the Eastern Partnership Countries officers could be updated for the purposes of other real-world case-studies. Stakeholder analysis could be used for selecting a right audience for the participatory workshops (Ridder et al., 2005).

On value added, dissemination potential and recommended further steps

The participatory methods based on systems thinking could help facilitate a structured discussion of water-related draft strategies and plans at the national or Basin Council levels, involving a broad range of stakeholders representing the government, water users, expert community and other actors from different sectors and all levels of the water governance system. This concerns not only Eastern Partnership but also other countries in the EECCA region and beyond facing big uncertainty (not least related to future water demand and availability, impacted by climate change).

Respective *guidelines for facilitators* would be helpful and could be developed and disseminated as the next step. In parallel, local actors (including potential facilitators), expert community and donors should be more widely familiarised with this approach through respective *awareness raising and capacity development* efforts.

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Appendix 1. Methods description.

Multi-criteria decision analysis

Multi-criteria decision analysis (MCDA) is a method to deal with conflicting objectives in decision-making. A conflict among objectives (criteria) becomes apparent when there is a need to evaluate and prioritize different policy options. MCDA helps to structure complex decision problems and to make decisions being better informed in what concerns trade-offs between criteria. Based on stakeholder processes, multi-criteria decision analysis often works with so-called stakeholder preferences.

Criteria can conflict even if a decision is to be taken by a single stakeholder. The presence of multiple stakeholder groups, which should agree on a joint decision, multiplies the complexity and the number of trade-offs. For instance, in the context of the Sustainable Development Goals, some stakeholders can prioritize most urgent policy interventions, while others will speak in favour of more long-term measures.

MCDA supports decision-makers in dealing with such complex problems and identifying trade-offs by ranking available alternatives. MCDA is based on the Delta method, which allows for including uncertainty and imprecision of data and weights (Danielson & Ekenberg, 2007). Alternatives are evaluated using qualitative and quantitative indicators, whereby decision-makers either seek to minimize losses or to maximize gains. In a participatory process, stakeholders rank and weight criteria or alternatives according to their importance in achieving their goals. This enables that the comparison between two alternatives leads to one alternative clearly outperforming another under any circumstance (Sundgren, Danielson, & Ekenberg, 2009).

MCDA has plenty of applications, in particular, for planning of water infrastructure under competing stakeholders' preferences (Aubert, Bauer, & Lienert, 2018; Lienert, Scholten, Egger, & Maurer, 2014).

Qualitative systems mapping

This method aims to specify the system's boundaries, components and (causal) links between them for a system underlying a given policy issue delivering a graphical visualization of these. The information on the system structure is important because the structure defines the behavior of a system in time, that is its dynamics. When the links connect several components of a system into a loop, one can speak about a feedback loop. Feedback loops are either reinforcing (the values of the components are growing in every round that a trigger has kicked off) or balancing (the feedback loop dampen the impact of a trigger down). Feedback loops are essential to anticipate a response of the system to different stresses or policy interventions; their analysis can lead to unexpected, counter-intuitive results (Sterman, 2002).

Qualitative systems mapping is useful for analysis of wicked problems in case quantitative data availability is limited. Typically, this method is applied when the problem under consideration is rather new to the stakeholders participating in its solution (and hence their experience is not sufficient to have confidence in making decisions), or the nature of the considered system is so complex that it is impossible to oversee all important factors and their interrelations (Kanter, 2018).

Qualitative systems mapping consists of three main phases. First, all potential factors that may have an impact on the system in question are listed and assessed in terms of their importance for the considered system. Some of them are chosen as the system "outputs" – the variables whose state is of the highest importance in the context of the considered problem. Some other factors are chosen as "triggers", which means that they can be directly affected by the decisions to be taken. Second, participants of the process (stakeholders and/or experts) connect the selected factors (components) to each other illustrating the directions of influence.

Moreover, strength and polarity (positive or negative) of the impact could be specified. Third, feedback loops, that define the behavior of the system are identified (Wildemeersch, Rovenskaya, & Ilmola, 2017). A systems map could be used as a research tool for further exploration and quantitative modeling, or as a tool for consensus building amongst stakeholders and for exploring possible actions (Tiller, De Kok, Vermeiren, & Thorvaldsen, 2017).

Analysis of a systems map is able to reveal several issues that are important for policy planning: (i) what are the most important components of the system, (ii) how the impact is spreading throughout the system, and (iii) what are the main implications if one of the components of the system is impacted.

After the systems map is created, participants can choose the most critical factors for the dynamics of the considered system. Based on this choice, strategic goals for the considered system can also be formulated.

Morphological analysis

Morphological analysis (Ritchey, 2011) is a systematic method for considering multiple realizations of uncertain factors. First, key uncertainties in the considered system are identified and assigned as column headers of the so-called morphological matrix. Second, possible alternative (often extreme) mutually exclusive states for each uncertain factor are developed. Each such alternative state is assigned to one cell of the corresponding column of the morphological matrix.

The uncertainties can be selected with the help of the systems map of the considered system. In a participatory setting, this selection can be made through a facilitated discussion. Generation of the alternative states for each uncertainty can be done in mini-groups, but a joint discussion is recommended to finalize the entire morphological matrix and ensure its consistency.

Table 1. Sample view of a morphological matrix.

Uncertainty1	**Uncertainty2**	**Uncertainty3**
Uncertainty1.AlternativeState1	Uncertainty2.AlternativeState1	Uncertainty3.AlternativeState1
Uncertainty1.AlternativeState2	Uncertainty2.AlternativeState2	Uncertainty3.AlternativeState2
Uncertainty1.AlternativeState3		Uncertainty3.AlternativeState3
		Uncertainty3.AlternativeState4

Source: authors' own elaboration

Scenario planning

Scenario planning is an important technique used in future studies. Since long, it has been used by government planners, corporate managers and military analysts as a powerful tool to aid decision making in the face of deep uncertainty (Leitner et al., 2018). It aims at a systematic exploration of plausible futures, focusing especially on polar realizations of uncertain factors.

Each scenario is a narrative that represents an internally coherent picture of a possible future. Scenario planning usually combines the following features: (i) plausibility and feasibility as well as public acceptance – scenarios should be close to the current reality, assuming at least some consistency between the currently observed trends and future developments, (ii) generation of new ideas – scenarios should be novel and differ substantially from the present situation, (iii) covering a wide range of uncertainties – scenarios should cover as many alternatives as possible, even low-probability, extreme scenarios can be included and analyzed.

To define scenarios, a morphological matrix can be used. Every scenario is based on a consistent combination of alternative realizations of various uncertain factors. Typically, only few combinations pass the consistency test. In addition to consistency, combinations to be used to create scenarios should be sufficiently dissimilar (Schoemaker, 1995). In a participatory setting, scenarios and scenario narratives can be created in mini-groups facilitated by a facilitator.

Table 2.Two sample alternative scenarios (light-blue and dark-blue) created using a morphological matrix.

Uncertainty1	**Uncertainty2**	**Uncertainty3**
Uncertainty1.AlternativeState1	Uncertainty2.AlternativeState1	Uncertainty3.AlternativeState1
Uncertainty1.AlternativeState2	Uncertainty2.AlternativeState2	Uncertainty3.AlternativeState2
Uncertainty1.AlternativeState3		Uncertainty3.AlternativeState3
		Uncertainty3.AlternativeState4

Source: authors' own elaboration

Scenario planning is widely applied, in particular, in the water sector strategic planning (Dong, Schoups, & Van de Giesen, 2013) producing qualitative, semi-quantitative and quantitative scenarios covering either only the water sector or the entire Water Nexus system.

Robust decision-making

Robust decision-making is an analytic framework which aims at identifying strategies "robust" (i.e., insensitive) under the presence of uncertainties in the future development of the considered system. A robust strategy is formed as a portfolio of policies leading to the strategic goals under all (or most of) plausible future scenarios (Groves & Lempert, 2007)[3].

The initial set of policies (usually several dozens) is established based on various inputs (strategic documents, good practices, the experience of comparable countries/institutions, etc. can be used). Participants of the process can also provide their suggestions. The policies from this set are evaluated and ranked based on four metrics: (i) relevance, i.e., expected effectiveness in achieving specified strategic goals, (ii) cost, i.e., implementation (direct) cost to the government and affordability in the current situation, (iii) technical feasibility and (iv) political feasibility. The resultant evaluation and ranking is a consensus of a group (or a mini-group) that performs the task. Such an evaluation is done for each scenario of a plausible future. Policies

[3] Robust decision-making framework has a variety of specifications; here a variant tailored specifically for the outlined participatory strategic planning process is presented.

which have low relevance and high cost/affordability, as well as low technical or political feasibility are discarded (Figures 4, 5, and 6).

Figure 4. Policy evaluation. Stage 1. Policies in the red area are discarded

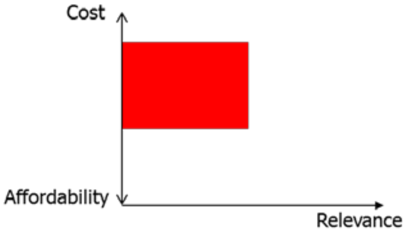


Figure 5. Policy evaluation. Stage 2. Policies in the red area are discarded.

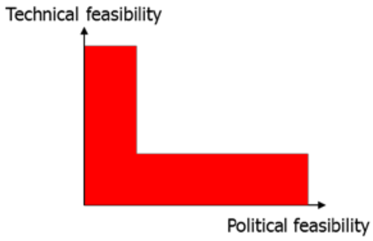


Figure 6. Policy evaluation. Stage 3. Policies in the red area are discarded.

Source: authors' own elaboration

At the next stage, the pre-selected policies are evaluated and ranked with regard to achieving the identified strategic goals. Policies allowing achieving more goals receive more points; this evaluation is done for each future scenario. Policies, which happen to be ranked high in all future scenarios, form a "core strategic package" constituting a "robust" ("no-regret") strategy. One can relax the requirement that the robust policy must be ranked high in all future scenarios and instead require that it ranks high in most of them (Lempert & Collins, 2007). The exact way of defining robustness should be discussed with the process participants depending also on their understanding of the strategic goals.

The policies which are useful only for some scenarios can be added to "scenario-dependent" packages and should be applied once policymakers obtain signals indicating which scenario path the considered system is taking. Scenarios also help to highlight mutually exclusive policies.

Appendix 2. Enabling case-material

Description of the imaginary country ALBAGUMia (the Legend)

List of abbreviations:
BA - basin administration; **EU –** European Union; **HPS** – Hydroelectric Power Station**; IWRM -** Integrated Water Resource Management; **LPA –** local public administration; **MAC** - Maximum Allowable Concentration; **PM** - Prime-Minister; **SDG** – sustainable development goal; **WFD** - Water Framework Directive; **WSS –** (municipal, communal) water supply and sanitation;

Disclaimer: *the (imaginary, hypothetical) countries presented below do not exist and have never existed in the past; all eventual similarities or features common with features of existing countries are occasional.*

Political geography

The hypothetical (imaginary) country named **ALBAGUMia** is located between the (hypothetical, imaginary) North Sea and the (hypothetical, imaginary) South Sea. It occupies the land area of about 220 000 km^2 (see Figure 7), and has the population amounting to 12 million people (called **ALBAGUMians**), according to the 2016 census.

The capital city - **Guma-city** has the population of 1.6 million people; there are also two other major cities in the country – **Nordov** with population of about 450 000 people and **Alburg** having 350 000 inhabitants.

The Central Chain consisting of hills and moderately high mountains spans between east and west dividing the country into a relatively small northern part having no access to seas, and a bigger southern part located between the Central Chain and the South Sea. The Central Chain acts as a watershed.

ALBAGUMia has common borders with the following countries (listed in the clockwise direction, starting from the west): Western Neighbour (an EU Member State); Northern Neighbour (not a member of any supranational block); North-Eastern Neighbour (member of the Eurasian Economic Union – EAEU); Eastern Neighbour (concluded the Association Agreement with the EU).

The usage of water resources from the trans-boundary and boarder rivers requires inter-state agreements to be implemented and enforced.

Political system and geopolitical situation

ALBAGUMia is a parliamentary democracy, with the President having mainly formal and representative functions. Elections are held every four years. The next elections will be in mid-2019. A coalition of parties having the majority in the Parliament (one chamber, 125 seats) forms the Cabinet (National Government) consisting of the Prime-Minister (PM), three vice-PMs, and fifteen ministers and heads of central government bodies.

Political preferences of the population are divided almost equally between the currently ruling moderate-right parties (National Liberals et al.) promoting a closer cooperation and integration with the EU and generally with the West, and the moderate-left parties (Left Democrats et al.) promoting a mixed approach aiming at finding a model that would allow combining closer cooperation with both the European Union and the Eurasian Economic Union (EAEU).

The deep political and societal divide, together with the economic and fiscal problems (see below) cause the persistent political instability, with a new government coming into forth or government restructuring occurring every two years or so.

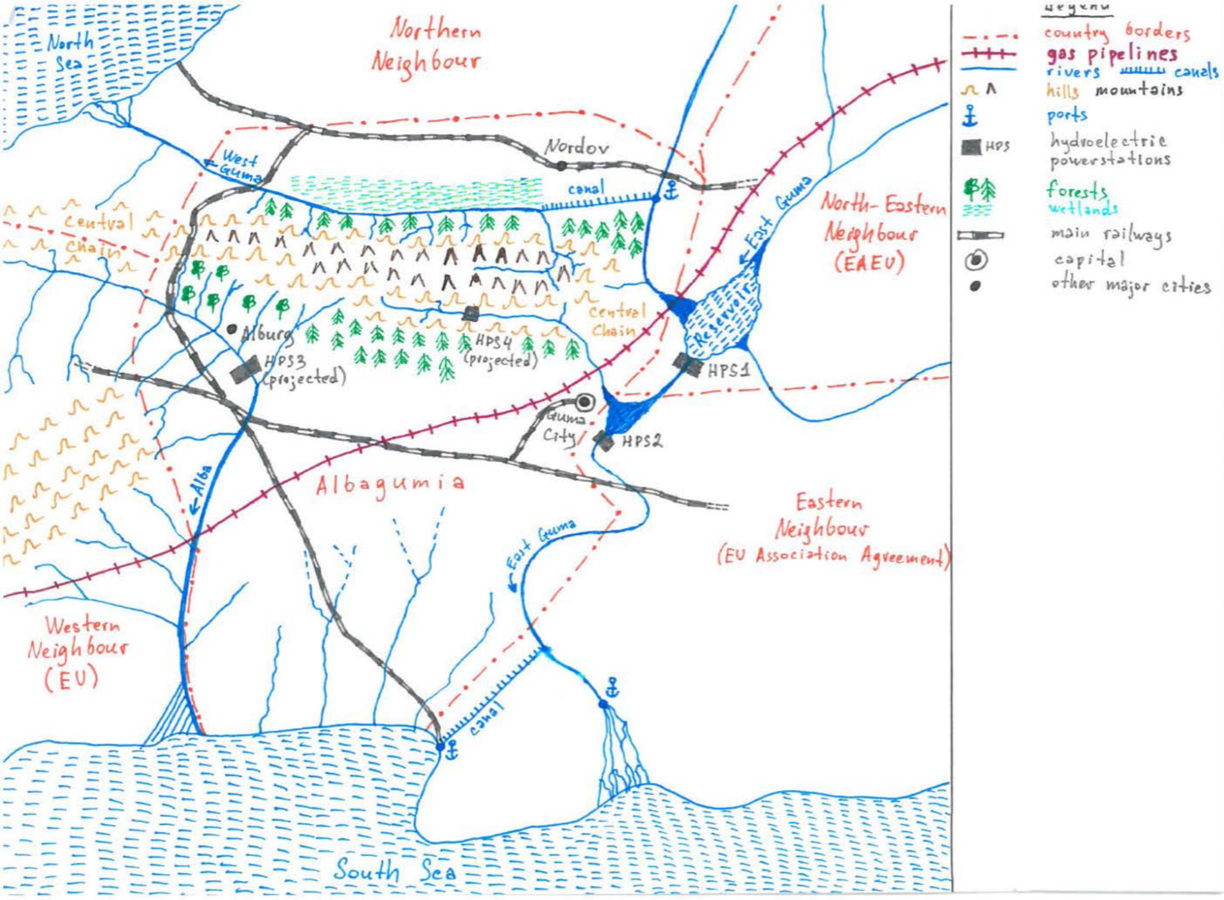
Presently, the Cabinet represents the ruling coalition led by the National Liberals, while the opposition led by the Left Democrats has formed a shadow government and is ready to take over the Cabinet at any time. This may well happen soon as the outcomes of the upcoming mid-2019 elections are hardly predictable.

Economy, public finance, and infrastructure (other than water infrastructure).

The main economic sectors in **ALBAGUMia** include agriculture (crops and livestock) and food processing industry; mining (extracting building/construction materials and brown coal), energy and utility sector, textile/light industry, construction, services (financial and non-financial, e.g., transport, tourism, and recreation).

ALBAGUMia is a lower-middle income country. Its GDP (Gross Domestic Product) declined in 2008-2010 (by 15% in total over the three years), showed a modest growth (1.2-1.5% per annum) in 2011-2014, and has stagnated afterward (staying at +/- 0.5% level of the year-on-year change). As a result, in 2017, the PPP (purchasing power parity) GDP was estimated at 2750 USD per capita. The median household income was 115 USD per capita per month. The level of shadow economy remains quite significant, about 20% of GDP, according to the expert estimates.

Figure 7. Map of ALBAGUMIA.



Source: authors' own elaboration

ALBAGUMia's trade balance and national account balance of **ALBAGUMia** have been negative for the last ten years; the economic situation is not sustainable as imports exceed exports. Consequently, the budget deficit and external debt have also been increasing.

A severe obstacle to the enhancement of exports is non-tariff barriers, such as quotas and production standards different from those accepted in the EU, as well as political uncertainties in the West-EAEU relations.

The recent economic decline and the subsequent stagnation affected rural areas more than urban areas: over the past decade, the migration of the labour force from rural areas to cities within ALBAGUMia and abroad has been significant. About 30% of the ALBAGUMia's labour force is currently working abroad, half of which work in North-Eastern Neighbour and another half work in the EU.

ALBAGUMia's economic situation heavily depends on the inward remittances, which amounted to about 20% of the national GDP from 2000 to 2017. At the same time, in 2015-2017, the fiscal deficit amounted to 15-20% of the consolidated public budget, or to 5-6% of the GDP. Loans and grants from international donors, notably, International Monetary Fund (IMF), as well as external borrowings (for example, Euro-bonds) help to cover the deficit, but the outstanding external debt have reached a critical value of 110-120% of GDP limiting the potential for further external borrowings.

The national currency, albagum (ABG), has depreciated by 30% against the USD and EUR over 2015-2017 with the present exchange rate being 20 ABG = 1 EUR. The inter-bank interest rate is 6-8% per annum.

There are three major railways in **ALBAGUMia** – one of them connects Nordov to the North Sea and North-Eastern Neighbour, another crosses the country from east to west with a branch line to Guma-city, connecting it with Eastern and Western neighbours and one more connects both railways with a port city of the Eastern Neighbour on the South Sea.

Population and main ethnic groups

The total population of **ALBAGUMia** stagnated from 2000 to 2007 and dropped by about 20% from 2008 to 2016 due to the negative natural growth and the high emigration. Presently, the rural population amounts to 45% of the total population.

There are two major ethnic groups in **ALBAGUMia**. Albans – people living in the Alba river valley and in between the Alba and East Guma rivers being a majority. They speak Alban language. Most of the population living in the northern part of the country speak Slavic language; while in the eastern and southern part of the country, there are also Greek, Jewish, Turk and other minorities.

Every citizen speaks either Alban or Slavic language; many citizens are bilingual. Alban and Slavic languages have special status by law: Alban is a state language while Slavic is an official language, meaning that each government body and LPA must accept documents in both the state and the official language. However, the language issue remains politically sensitive in the country.

Hydrology

There are three major river basins and four basin districts in **ALBAGUMia:**

- Alba river basin in the western part of the country with the basin district occupying 30% of the country's land area with the annual run-off being 7 km3

- West Guma river basin in the northern part of the country with the basin district occupying 20% of the country's area with the annual run-off being 11 km3;

- East Guma basin in the north-east and eastern part of the country with the basin district occupying 32% of the country's area with the annual run-off being 10 km3; A 130-km Canal connects the West and East Guma rivers; and finally,

- a few small watercourses in the central part of the country form the isolated South Sea basin district occupying the remaining 18% of the land area with the annual run-off being 2 km3.

The annual and seasonal variability of the annual run-off in all rivers is significant: e.g., the wet-to-dry-year annual run-off ratio in case of the Alba river is about 250%; while in the South Sea basin district the April-to-August monthly run-off ratio reaches 15-20 times. With the climate change in future, according to scientists, these numbers will further increase.

Groundwater (GW) reserves are not well investigated and are used foremost for domestic water supply in small towns and rural settlements. The median depth of boreholes amounts to 200 meters. However, the fresh groundwater in the Alba river basin often is contaminated with fluoride, iron, selenium, etc. with concentrations at 5-10 MAC.

There are several lakes and a few hundreds of artificial ponds in the country, used foremost for the commercial fishery, tourism, and recreation. There are forests located close to the Central Chain, and there are some wetlands in the norther part of the country, while the most fertile arable land is in the central and southern parts of the country where lack of water resources is a barrier to developing irrigated agriculture.

Demand and key water use

The demand for water is formed through three major agents: neighbouring countries, households (HHs) and key economic sectors in ALBAGUMia (notably, agriculture). The demand for both water resources and water infrastructure needs (and hence investments in the water sector) in ALBAGUMia are/will be driven by (i) demographic dynamics (growth of population, migration from rural to urban areas, labour migration abroad and immigration back to ALBAGUMia); as well as by (ii) the overall economic development and (iii) structural changes in ALBAGUMia's economy.

The future structure of **ALBAGUMia's** economy is dependent on plans of the Government and private economic agents.

Presently, the key consumptive water uses in **ALBAGUMia** are: agriculture, food processing industry and tanneries (55% of the total freshwater abstracted); other processing industries developed mostly in the northern part of Albagumia (12%), cities / domestic (potable) water supply (15%); mining and the thermal energy sector (10%); and others (8%). Non-consumptive water uses include hydropower, water transport, tourism and recreation at water bodies.

Agriculture is a major source of water pollution, which includes discharges of hazardous pollutants from pig farms and diffuse pollution due to the application of toxic agri-chemicals. Municipal wastewater sector is the second largest polluter followed by industrial pollution.

Water infrastructure

Water infrastructure in ALBAGUMia is not well developed, obsolete and requires modernization, without which the risks of technical accidents on water systems (already high) get higher every year. In the current conditions, the state has no money to invest in the water infrastructure; instead it seeks for foreign investors or external assistance such as potential international financial institutions (e.g., IMF, World Bank) loans, and funds from the EU and other donors.

The North-Eastern Neighbour has an HPS on a reservoir on East Guma upstream and the Eastern Neighbour also has an HPS on East Guma downstream. Both are situated close to the eastern border of Albagumia and some part of its land (up to 26 km2 in total) was flooded due to construction of respective reservoirs. On the other hand, ALBAGUMia imports some electricity produced by the HPSs and jointly with the natural gas import it helps the country to cover the energy balance deficit.

Water management

There exist basin administrations (BAs) created about 20 years ago in each of the four river basin districts, but operations of the BAs suffer from the lack of skilled staff (and ageing of current staff without new generations replacing it), equipment and funding.

Basin councils are in their infancy; two out of four councils held just one meeting in their history, while the others two have never met so far, and exist only on paper.

The water infrastructure is operated by both public operators managing major dams and reservoirs, dykes and inter-regional water mains, and private operators (e.g., WSS systems in two big cities are operated by private entities under 15-year lease agreements). Business models for operating WSS systems differ in the different parts of the country, i.e., in the northern part of the country, regional water utilities operate WSS systems in villages while in the other parts of the country each municipality has its own utility, resulting in the situation of too many too small operators.

An attempt to regionalise WSS services in rural areas to the south of Central Chain and involve private operators failed due to the unwillingness of local public administrations (LPAs) to participate (by law, LPAs are responsible for organising the provision of communal services: WSS, municipal waste management, etc. to the population living on respective territory).

Water tariffs for households and firms are kept low, and the government subsidises water utilities, yet at a very minimal level.

Water-related problems and challenges

Renewable fresh water resources in **ALBAGUMia** amount to 2500 m3 per capita per annum which is above the threshold of water stress. The problem is, however, that firstly, the variability in precipitation and annual run-off is significant and further increasing; and secondly, water is unevenly distributed over the regions. While the northern **ALBAGUMia** frequently suffers from heavy rains, the area in-between rivers Alba and East Guma often suffers from droughts.

The water intensity of the national GDP as well as of such key sectors as agriculture, mining, and processing industries is **high and only marginally improving**.

The country's **energy security** is rather **low**: it depends on the import of energy resources (32% of total domestic consumption of energy, mainly gas supplied by the North-Eastern neighbour; also, a major gas pipeline situated in Albagumia is used to transport gas from the North-Eastern neighbour to the Western Neighbour). At the same time, there is a big potential for the hydro-energy based on domestic rivers, which is currently only utilised at 2% at maximum. It has been suggested to build a few hydro-power plants upstream of the Alba river and one on the tributary of East Guma in the Central Chain mountains, however, none of them has materialised so far because of (i) the **lack of capital** for major hydropower projects, and due to (ii) **strong resistance** to building new dams from local environmentalist NGOs.

Similarly, the potential of rivers to be used for the inland water transport is only marginally utilised. Rivers West Guma and East Guma and the canal connecting them are part of the **E777 pan-European waterway** "from the North Sea to the South Sea" with the potential to carry **200 million tonnes of freight** per annum. There are two major obstacles. First, presently the required depth of the waterway is ensured for only three months a year, instead of 7 months navigation required by agreement with the EU on pan-

European transport corridors. Second, the Canal between the West and East Guma rivers was built some 150 years ago, without any lining, and now requires a total rehabilitation to make it wider and deeper. The whole waterway needs to be deepened and prevented from sand and sediment setting, but the public budget cannot afford respective investment. The private sector participation scheme has not been possible due to high risks associated with such a capital-intensive long-term project in a country over-burdened by the external debt (**ALBAGUMia** has CC- rating with negative perspectives).

Water-related hazards are another significant challenge. Over 400 out of 5000 settlements (small towns and villages) in the country are located in landslide prone areas, and each year landslides destroy about 150 rural houses, with the government being the last resort insurer for people who lost their homes.

Over 2008-2017, **ALBAGUMia** experienced **two severe droughts** which significantly affected agriculture (more than 30% of the harvest was lost) and interruption of potable water supply in 100+ settlement, as well as **three major floods** in both Alba and East Guma river basins with significant damage (life and property lost) and economic losses.

One of the reasons of floods in river Alba basin was a lack of storage capacity to regulate the flow upstream and accommodate for spring flooding. Construction of such reservoirs would be a solution, but local environmentalist NGOs – politically powerful lobbyists - strongly oppose to the building of any new dams. Another source of risk is the dyke recently built by Western Neighbour on the right bank of Alba River. It protected their country but intensified floods on the left bank of Alba River.

Position on water policy

All political parties in **ALBAGUMia** recognise the importance of achieving the SDGs in general, and the water-related goals in particular, as well as fulfilling other international and bilateral commitments. They would like to harmonise the national water policy and legislation in accordance with the principles of the EU's Water Framework Directive (WFD) & of Integrated Water Resource Management (IWRM) and the best international practices of water management worldwide.

Recognising the severity of the water-related problems their country is facing, they agree on the urgency of development of a new national Water Strategy compliant with the international obligations of **ALBAGUMia** and the aforesaid principles. It shall be supported by a mid-term (4-5 years planning horizon) implementation plan.

* * *

The Government of **ALBAGUMia** hopes that a new **Water strategy** with **water, food and energy security for the present and future generations of Albagumians** as the overarching strategic goal would help address the problems and challenges.

Appendix 3. Data collection tasks

Task 1:

Read the Legend describing the imaginary country **Albagumia** and its current situation in the water sector. Based on the experience in your country, suggest **drivers and factors,** which will affect the water sector development in this country, classifying them into:

- Internal (originating inside the country), or
- External (originating outside the country)

In each category, label each identified factor as Political (P), Economic (E), Social (S), Technological (T), Ecological (Ec), or Legal (L) – hereinafter called **PESTEL categories**.

Note that there are no right, or wrong answers here, so please suggest and classify factors as you see it. Even if some features of Albagumia and its environment are not explicitly described in the legend, but your intuition tells you that the setting suggests some important implicit factors, please list them as well.

Suggest as many factors as you can, **total about 20 factors** would be a good number. For example, climate change may be a factor, which would be classified as "external" and "ecological". Construction of dykes or hydro-electric stations on trans-boundary/boarder rivers may be another factor, etc.

Further, suggest the polar values for the uncertainty inherent in each suggested driver and factor.

For example, in case of climate change as a factor, uncertainty would be the degree of global warming, i.e., the expected global **temperature increase** with one polar value being a moderate temperature increase (most scientific sources would say it is about 1.5-2C° by the end of the 21st century) vis-à-vis another polar value being an extreme temperature increase (scientists would say it may reach up to 7-8C° by the end of the 21st century).

Task 2:

Based on the experience in your country, suggest the aims (objectives), the government of the imaginary country should want to pursue when setting a policy concerning water. Again, there are no right, or wrong answers here, so please suggest as many aims as you can think of. Between two and five aims would be a good number. For example, "modernise existing water infrastructure" may be an aim. "Construct a Hydro-Power Station to reduce dependence on energy imports" maybe another aim, etc.

Task 3:

Based on the experience in your country, suggest major policy actions that the government of the imaginary country could implement to achieve each of the aims listed in Task 2. Classify each suggested action into PESTEL categories (see Task 1). For example, "increase tariffs for irrigation water" may be a policy action to achieve the aims to modernise the water infrastructure from Task 2. "Increase tariffs for water" is an economic policy (E) action. Same concerns "increase surface water abstraction fee rates".

Appendix 4. Supplementary data

List of pre-selected criteria for the Multi-Criteria Decision Analysis method

- Economic growth (GDP and household (HH) disposable income increase)
- Peace and security (no transboundary and regional conflicts)
- Population well-being (incl. wealth, health status, work-life balance, subjective well-being etc.)
- Ecosystems health (ecosystem diversity, viable populations of native species, evolutionary processes)
- Political stability and rule of law
- International image of the country (position in various international rankings)

List of pre-selected factors for the Systems Mapping Session

Disclaimer

- ❖ The notions under numbers are short names to be used on cards
- ❖ The texts in bullet points are more detailed explanations to be supplied to the participants for reference
- ❖ The classification into PESTEL categories is just for practical convenience; it is understood that some factors relate to more than one category
- ❖ Numbers within each category do not represent any kind of prioritization; factors are ordered randomly

P - Political

1. Geopolitics
    - An overall political situation including the country's membership in various political and trade blocks, e.g., the association with the EU, and their influence
    - Overall relations with neighbouring countries; water-related conflicts with neighbouring countries; competition for water resources
2. International commitments on water
    - Participation in multi-lateral agreements, e.g., the Water Convention
    - Participation in bilateral agreements on the use of shared water resources, e.g., on transboundary rivers
    - Participation in international river basin district (IRBD) management schemes
    - Compliance with the international good practices concerning water, e.g., the human right on access to safe and affordable potable water and IWRM principles
    - Commitment to water-related SDGs and Paris agreement
3. Internal politics
    - Political stability in the country
    - Position of ruling party(s) on the environment and water
    - National economic development strategy; the role of the water sector therein
4. Water governance and management
    - Existence and the fit-for-purpose of the Water Strategy and the WSS Strategy, existence of a feasible Action Plan
    - Quality of water governance and management; degree of the shared decision-making in water management (e.g., the existence and importance of Basin Councils) and degree of collaboration of multiple-level stakeholders

- Regionalization of the water planning, heterogeneity of policies for different locations taking their specifics into account (e.g. rural/urban, small/large cities)
- Rational use of governmental finances in the water sector and of other domestic financial support mechanisms in the sector; corruption level in the water sector, and in the economy in general

E - Economic

1. National economic development
    - GDP and GDP growth rates
    - GDP per capita, disposable income per capita and income disparity
    - Ability-to-pay (ATP) for water services
2. Trade
    - Global and regional demand for water- & energy-intensive products
    - Imports and exports of water- & energy-intensive products
    - Barriers to foreign trade, including those for water-intensive products
    - Barriers to labour migration
    - Virtual water flows across borders
3. Water budget
    - National and regional budgets allocated for the development of the water sector (in absolute and relative terms)
    - Water-related R&D spending
4. Finances for and economic incentives in the water sector
    - Tariffs for WSS and irrigation water; flexibility; cost-coverage ratio
    - Collection efficiency
    - Other financial and economic mechanisms for regulating the relations between water systems operators and water consumers
    - Equity of access to, and affordability of, WSS for different regions & population groups
    - Solidarity mechanisms in the water sector, e.g., the state support to vulnerable water consumers or subsidised tariffs; solidarity funds
    - Financial health of WSS companies (profitability, the level of indebtedness etc.)
    - Tariff-related incentives to increase water use efficiency and reduce water losses, e.g., water use fee or tax
    - Economic and fiscal incentives for technical and institutional innovations in the water sector
    - Investment attractiveness of the water sector, privatization of WSS companies, degree of the private sector participation (PSP), public-private partnership (PPP) in WSS
    - Official development assistance (ODA) & FDI for the water sector development
5. Market mechanisms
    - Competition on the water market (goods and services), bidding procedures
6. Using waterways for freight
    - Demand and potential for using waterways for freight
7. Water intensity
    - Water intensity of the major sectors of the economy (agri-food; energy, incl. hydro-power share; mining; processing and other water-intensive industries; utility services for HHs)
8. Water abstraction
    - Total fresh water, including surface and ground water
9. Water demand by key economic sectors
    - Demand for water by the major sectors of the economy (agri-food; energy, incl. hydro-power share; mining; processing and other water-intensive industries; utility services for HHs)
10. Agricultural water demand
    - Demand for water by agriculture (surface and ground water)

- Land use structure

11. Recreational and medical use of water
    - Potential and demand for the recreational and medical use of water
12. Vulnerability to water-related disasters
    - Level of development of the insurance sector for HHs and firms
    - Affordability of, and coverage by, insurance against water-related hazards

S - Social

1. Demography
   - Natural population growth
   - Immigration and emigration flows
   - Urbanization level, urban-rural population ratio
2. Health
   - Including hygiene and water-borne diseases
3. Consumption and behavioural patterns
   - Consumption of water-intensive goods and services
   - Behavioural water use patterns (e.g., showers/baths use)
   - Lifestyle (e.g., the popularity of water leisure)
   - Willingness-to-pay (WTP) for clean water, foremost by HHs and small farmers
   - Acceptance of new technologies (e.g. water saving)
   - Attitude to and compliance with the state water policies
4. Human capital of the water sector
   - Education and skill level of the water sector staff
   - Salary level in the water sector vis-à-vis other sectors of the economy
5. Cooperation of water users
   - E.g., Water Users Associations; drinking water cooperatives etc.
6. Public awareness of water related problems
   - Public awareness of the pollution levels and their health effects
   - Public awareness of impacts of climate change
   - Public awareness of and preparedness to the water-related hazards (e.g., mud-flows, severe floods and droughts, landslides etc.)
   - Public awareness of the responsible water use concept
   - Activity of NGOs (e.g., information and education campaigns)
7. Water terrorism and diversions
8. Social tension level

T - Technological

1. Water supply infrastructure for industry
   - Availability and quality of the water supply infrastructure (WSS, irrigation): the coverage level; installed capacity versus the factual demand for water; accumulated depreciation; energy intensity
2. Water supply infrastructure for agriculture
   - Rural WSS; on-farm irrigation
3. Water supply infrastructure for HHs
   - Including the use of water meters and smart payments, water saving technologies and modern plumbing
   - Use of water purification (cleaning, filtering etc.) for drinking water
4. Return water, storm water and wastewater collection and treatment

- Availability and status of collector-drainage systems
- Availability and state of storm water systems in settlement; percentage of collected storm waters passing appropriate treatment

5. Hydro-technical infrastructure
    - The level of development and state of water reservoirs, dams, dykes, canals etc., including the flood protection infrastructure
6. Sanitation
    - Availability of piped or quality on-site sanitation for HHs; percentage of collected wastewaters passing appropriate treatment
7. Monitoring systems
    - The level of development of water quality and quantity monitoring systems
    - The preparedness and effectiveness of services responsible for the mitigation of the consequences of water-related disasters
8. Technologies reducing pollution
    - Pollution sources separation in wastewaters, wastewater treatment technologies, zero-discharge concept, waste water reuse/recycling
9. Availability and affordability of technical innovations
    - Availability and affordability of new technologies & equipment, e.g., water use monitoring, irrigation, water saving, cleaning, desalination etc.
    - Availability and affordability of low-water-intense energy forms for the water sector, e.g., solar-powered dumping; small run-of the river hydro-electric stations etc.
10. Melioration
11. Water quality – use mismatch
12. Technical accidents and disasters
    - Probability and severity of technical accidents and disasters in the water sector
13. Use of toxic agrochemicals, synthetic fertilizers and detergents in agriculture

E- Environmental

1. Precipitation and run-off
    - As inputs to the national water mass balance (for fresh water resources)
    - Volumes and variability
    - Share of water inflows and outflows in the national water mass balance
2. Evaporation
    - Water evaporation from reservoirs
3. Surface water availability
    - As described by e.g., water stress index
4. Ground water availability
    - Includes also the use/replenishment ratio
5. Surface water quality
    - Includes also micro-pollutants
6. Ground (potable) water quality
7. Point source water pollution
    - Point source pollution from industry, energy and urban/municipal wastewaters – mainly relevant to surface water
8. Diffuse water pollution
    - Water pollution from agriculture – mainly relevant to ground water
9. Climate change
    - Impact of climate change on water resources, e.g., precipitation level and variability, and water infrastructure

10. Water-related natural disasters (floods, droughts, mud-flows, landslides etc.)
    - Frequency and severity
11. Ecosystems
    - Water ecosystems status (biodiversity, fisheries)
    - Eutrophication of surface water
12. Transboundary water pollution

L - Legal

1. Legislation on water management
    - Quality of the legislation
    - Compliance enforcement and prosecution
2. Legislation on water pollution prevention and control
    - Quality of the legislation
    - Compliance enforcement and prosecution
    - Design and implementation of water protection zones
    - Incentives to reduce point and diffuse pollution of water resource (pollution taxes and fees, eco-labelling etc.)
    - Standards for water quality and water services
3. Food-energy-water policy nexus: policy coherence
    - Coherence and inter-dependence of water policy with land-use/agri-food and energy policies (nexus)

List of pre-selected policies for the Robust Decision-Making Session

Disclaimer

- ❖ The notions under numbers are short names to be used on cards
- ❖ The texts in bullet points are more detailed explanations to be supplied to the participants for reference
- ❖ The classification into PESTEL categories is just for practical convenience; it is understood that some polices relate to more than one category
- ❖ Numbers within each category do not represent any kind of prioritization; policies are ordered randomly
- ❖ The list below is not aimed to be an exhaustive one. It rather presents a sample set of polices to inform the suggested decision-making support methodology. The actual list to be used for a real decision-making process would involve the expert knowledge and might contain hundreds of possible actions.

P - Political

1. More power to local level
    - ➢ Delegate more power and room for decision-making in the water sector to local authorities (in particular, on WSS and water bodies protection)
2. More coordination of authorities
    - ➢ Increase efficiency and coordination of the state authorities' activities on achievement of the priority goals in the water sector
3. Implement regionalization

- ➢ Implement the principle of regionalization of water services and sanitation (incl. designation of river basins and corresponding management structures)

4. Use more scientific basis
   - ➢ Increase credibility of decision making in the water resources management using scientific and expert knowledge about technological processes and ecological consequences of their application
5. Involve the public
   - ➢ Create enabling conditions for involving the public in addressing water use and protection issues

E - Economic

1. Increase investment
   - ➢ Create special funds for investment into the water sector and attract FDI
2. Develop and implement solidarity mechanisms
   - ➢ Develop and implement solidarity mechanisms in the water sector, e.g., the state support to vulnerable water consumers and WSS companies, state-subsidised tariffs
3. Make the users pay the full costs
   - ➢ Ensure that users pay the full costs of the water services they receive including the environmental and resource costs
4. Introduce water market
5. Enhance freight infrastructure
   - ➢ Rehabilitate canals and related infrastructure for freight shipping
6. Reconcile economic activity with environmental goals
7. Prioritize and enhance large-scale hydropower stations
8. Prioritize and enhance small-scale hydropower stations
9. Enhance adaptation
   - ➢ Enhance adaptation measures (incl. financial planning) to climate change and water-related hazards
10. Promote free competition on WSS market
11. Impose pollution taxes
12. Promote greening of the economy
13. Increase the volume of the agri-food production
14. Develop bio-agriculture

S-Social

1. Develop information awareness-increasing campaigns
   - ➢ Develop information awareness-increasing campaigns and educational activities on environmental problems and technologies
2. Enforce the compliance to the water protection legislation

T - Technological

1. Promote the use of water meters and smart payment schemes
2. Implement water recycling and industrial reuse systems
   - ➢ Implement water recycling and industrial reuse systems, improve wastewater treatment facilities using innovative technologies

3. Support transfer of new technologies
    - ➢ Support innovative scientific and technological developments based of world-leading achievements and technologies for water management activities
4. Raise drinking water quality and sanitation standards
5. Increase population coverage by WSS systems
6. Extend the monitoring range
    - ➢ Extend the monitoring range for both pollutants and observed areas, e.g. water bodies bottoms
7. Enhance and promote modern urban waste water cleaning technologies
8. Reduce the water quality-use mismatch
9. Use the desalination technologies

E- Environmental

1. Enhance and optimize the water storage system
2. Identify and prevent pollution
    - ➢ Identify and prevent pollution from different sources (including point and diffuse pollution)

Appendix 5. EUWI+4 EaP project workshop details

Agenda

18 October 2018. Wodak room, IIASA

9:00 – 9:15	**Registration of participants**
9:15 – 9:45	**Welcome and introductions** Moderators: Dr. Elena Rovenskaya (IIASA), Alexander Martusevich (OECD)
9:45 – 10:30	**Briefing on the principles of the Workshop** Moderator: Dr. Elena Rovenskaya
10:30 – 10:45	Coffee break
10:45 – 11:45	**Session 1** **Multi-criteria analysis** Moderator: Dr. Nadejda Komendantova-Amann
11:45 – 12:45	**Session 2-1** **Systems mapping. Introduction to the method. Identification of the most important factors** Moderator: Dr. Elena Rovenskaya
12:45 – 14:00	**Lunch**
14:00 – 16:30	**Session 2-2** **Systems mapping. Drawing a casual diagram. Identification of strategic goals and key drivers** Moderator: Dr. Elena Rovenskaya
16:30 – 16:45	Coffee break
16:45 – 17:30	**Session 3** **Morphological analysis** Moderator: Dr. Nikita Strelkovskii
17:30 – 17:45	Wrapping up of the first day of the Workshop
18:30 – 20:30	**Dinner**

19 October 2018. Wodak room, IIASA

9:00 – 12:00	**Session 4** (with a short break during the session) **Scenario development** Moderator: Dr. Nikita Strelkovskii
12:00 – 13:15	**Lunch**

13:15 – 15:15	**Session 5** **Robust decision-making** Moderator: Dr. Elena Rovenskaya
15:15 – 15:30	Coffee break
15:30 – 16:00	**Feedback and reflections** Moderator: Dr. Elena Rovenskaya
16:00 – 16:15	**Closing remarks** Moderators: Dr. Elena Rovenskaya, Alexander Martusevich

Participant list

EUWI+ partner countries' representatives	
Avaliani Temur	Chief Specialist, Hydrometeorological Department, Ministry of Environment Protection and Agriculture of Georgia
Bilokon' Volodymyr	Project Manager on sustainable use of water resources, Reform Supporting Team, Ministry of Ecology and Natural Resources of Ukraine
Chelidze Gizo	Head, Department of Hydro-melioration and Land Management, Ministry of Environment Protection and Agriculture of Georgia
Shatokhina Ganna	Chief Specialist, Department of Water Ecosystems and Resources, Ministry of Ecology and Natural Resources of Ukraine
Stankevich Aliaksandr	Director, Central Scientific Research Institute for Complex Use of the Water Resources, Ministry of Natural Resources and Environmental Protection of the Republic of Belarus
Tronza Serafima	Superior Consultant, Directorate of Integrated Management of Water Resources Policy, Ministry of Agriculture, Regional Development, and Environment of the Republic of Moldova
Voranava Viktoryia	Consultant, Department for Use and Protection of Water Resources Ministry of Natural Resources and Environmental Protection of the Republic of Belarus (Headquarters)
Facilitating team	
Ilmola-Sheppard Leena	Senior Research Scholar, Advanced Systems Analysis Program, IIASA
Komendantova-Amann Nadejda	Research Scholar, Advanced Systems Analysis Program, IIASA
Martusevich Alexander	Project Manager, Water Programme, Environment Directorate, OECD
Rovenskaya Elena	Program Director, Advanced Systems Analysis Program, IIASA
Strelkovskii Nikita	Research Scholar, Advanced Systems Analysis Program, IIASA

Special guest	
Gigl Florian	PhD Student, Graduate School Teaching & Learning Processes (UpGrade), University of Koblenz-Landau (Germany)

Photo 5. Participants of the workshop and the facilitating team.
L-R: V. Bilokon' (Ukraine), S. Tronza (Moldova), V. Voranava (Belarus), A. Stankevich (Belarus), G. Chelidze (Georgia), L. Ilmola-Sheppard (IIASA), T. Avaliani (Georgia), E. Rovenskaya (IIASA), N. Strelkovskii (IIASA), A. Martusevich (OECD), N. Komendantova-Amann (IIASA), F. Gigl (Germany), G. Shatokhina (Ukraine).

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