

Co-Creating a Safe Operating Space Framework for Water Resources: Insights from the Danube Basin case study

Silvia Artuso¹, Emilio Politti¹, Katarina Cetinic², Peter Burek¹, Sylvia Tramberend¹, Mikhail Smilovic¹, Taher Kahil¹

¹International Institute for Applied System Analysis (IIASA), Water Security Group ²Norwegian Institute for Water Research (NIVA), Section for Freshwater Ecology



EGU2025/Vienna



Significant increases in water withdrawals over the past century have driven severe environmental challenges worldwide, including water scarcity, declining water quality, and the loss of freshwater biodiversity.

These challenges are projected to intensify due to climate and societal changes in the coming decades.

LETTER • OPEN ACCESS

Human water consumption intensifies hydrological drought worldwide Yoshihide Wada, Ludovicus P H van Beek, Niko Wanders and Marc F P Bierkens Published 30 September 2013 - © 2013 IOP Publishing Ltd <u>Environmental Research Letters</u> Volume 3. Number 3. Citation Yoshihide Wada et al 2013 *Environ. Res. Lett.* 8 034036 DOI 10.1088/1748-9326/8/3/034036



Article Published: 23 May 2024

Current and future global water scarcity intensifies when accounting for surface water quality

Edward R. Jones ²⁰, <u>Marc F. P. Bierkens</u> & <u>Michelle T. H. van Vliet</u>

Nature Climate Change 14, 629–635 (2024) Cite this article

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Scientists' warning to humanity on the freshwater biodiversity crisis

Perspective | Published: 10 February 2020 Volume 50, pages 85–94, (2021) <u>Cite this article</u>



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What is the Safe Operating Space (SOS)?



Image Source: Time, https://time.com/5930093/amsterdam-doughnut-economics/

A sustainability concept for the complex Earth System (including for water resources).

• Social foundation

- Environmental/Ecological ceiling
- Environmentally safe and socially just space for humanity to thrive

Safe Operating Space for water resources



- Is rarely locally relevant and/or scalable
- Only accounts for single variables and ignores many relevant dimensions of the water system
- Does not consider stakeholder information and preferences



Defining the SOS for the Danube river basin

Develop a Safe Operating Space framework for the entire Danube river basin.

We follow **an inclusive and iterative participatory approach**, involving stakeholders in defining visions, values, and management options.







First Danube stakeholders workshop: November 2023







Objectives

 identify values, objectives, and priorities for sustainable water management in the Danube basin.





Co-developed Danube water indicators

Function	Process	Indicator
Regulatory functionality	Natural flow regime	Monthly mean flow alteration
	Longitudinal connectivity	Structural connectivity index
Water state	Uphold state	Aquifers recharge rate
	Drought resilience	Resilience index
	Extreme flood events	High pulses duration
	Ecosystem state	% of implemented eflows
Water supply	Sectoral water demand	Water supply reliability
	Agricultural demand	% of met demand
	Renewable supply	Share of demand met by renewable
Productivity	Navigation	Navigable days/year
	Habitat	Habitat availability
Chemical loads	Chemical status	WFD limits of P and N concentrations



Address: IIASA, Schlossplatz 1, A-2361 Laxenburg, Austria Email: permissions/Bilase.ac.at

Report

Imagining a Safe Water Space for Danube's Future Engaging stakeholders for the co-creation of a Safe Operating Space for the Danube basin November 22, 2023, Vienna, Austria

Silvia Artuso (artuso@iiasa.ac.at), Peter Burek (burek@iiasa.ac.at), Katarina Cetinic (katarina.cetinic@niva.no), Taher Kahil (kahl@iiasa.ac.at), Simone Langhans (simone.langhans@gmal.com), Emilio Politti (politti@iiasa.ac.at), Sabin Rotaru (sabin.rotaru@geoecomar.ro), Mikhail Smilovic (smilovic@iiasa.ac.at), Sylvia Trambered (trambers@iiasa.ac.at)

[13 May 2024]



www.sos-water.eu

https://pure.iiasa.ac.at/id/eprint/19926/





Second Danube stakeholders workshop: March 2025



Objectives

- Validate indicators and identify indicator thresholds
- Co-develop future scenarios and adaptation pathways



Second Danube stakeholders workshop: March 2025





Adaptations for the Upper Danube

SSP5	Adjusting Dam Operations
	Flexible low water repopulation infrastructure
	Multipurpose reservoirs
	On-farm water storage (soil moisture, groundwater, surface)
	Peak flow control structures in forest areas
	Riparian Buffers and Wetland Restoration
	Setting up flood control reservoirs or water impoundments
SSP3	Adjusting Dam Operations
SSP1	Floodplain reconnection for flood attenuation (room for the river, re-meandering)
	Improving water storing capacity in floodplains (Natural Water Retention Measures)
	Natural retention ponds in headwater areas
	Removal of damming, levees, embankments, constructions and infrastructure on the
	floodplain
	Restoring natural water retention spaces (ponds, lakes, reservoirs)
	Riparian Buffers and Wetland Restoration



SOS Water

Evaluation of Safe Operating Space

FUTURE SCENARIOS & ADAPTATION PATHWAYS

INDICATORS

INDICATOR THRESHOLDS



Thursday 1st May 2025 EGU2025 Session ITS3.5/HS12.2

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Evaluation of Safe Operating Space





Thursday 1st May 2025 EGU2025 Session ITS3.5/HS12.2

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Main points:

- Direct integration of stakeholders knowledge, experiences and values in the SOS for the Danube basin
- Relevance to decision-making and local scale
- Policy-relevance of analysis and findings
- Stakeholder endorsement
- Communication and network fostering between stakeholders







Thank you very much for your time!

International Institute for Applied Systems Analysis (IIASA) Schlossplatz 1, A-2361 Laxenburg, Austria

www.iiasa.ac.at www.sos-water.eu



This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement no. 101059264.

Silvia Artuso Water Security Group artuso@iiasa.ac.at