Water International

POLICY BRIEF
Water International
Number 20
June 2022

Source-to-Sea Management

Porec River Bay, Danube Gorge, Serbia.
© Freepik.

KEY POLICY MESSAGES

- The source-to-sea (S2S) concept has emerged as a promising management approach to sustaining the health of land, water, coastal and marine systems.
- The S2S approach can be applied to difficult challenges such as nutrients, sediment, pharmaceuticals, plastic waste and other diffuse and emerging pollutants.
- Linking science to inform management and closing the loop from practice to science is critical to advance S2S management.

Water International Policy Briefs (blue series) are based on thematic special issues of IWRA's flagship journal and published with the support of Routledge Press. They aim to provide high quality analysis and practical recommendations for policy makers on important development issues.

• Access Water International by becoming a member of IWRA: www.iwra.org

• or subscribe only to the journal at:
www.tandfonline.com/toc/rwin20/current

Routledge
Taylor & Francis Group

The source-to-sea (S2S) approach seeks to improve our understanding of the linkages between land, freshwater, coastal, and marine systems and to support efforts toward the effective and coordinated governance of these systems. A recent special issue of *Water International* explored practical applications of S2S along a number of dimensions.

CHALLENGES CASCADE FROM SOURCE-TO-SEA

Human activities impose a heavy burden on land, freshwater, coastal, and marine ecosystems. Pollution travels and must be stopped at the source to limit cascading impacts as it moves downstream. Think of the millions of tons of plastic that enter the ocean from land-based sources each year. Excessive nutrient loads from unmanaged agricultural runoff and inadequate wastewater treatment result in the spread of dead zones in our coastal and marine waters. We've altered many of our rivers so much that little or no flow, nor the essential nutrients and sediment carried within it, reach the sea. Then seawater intrudes into coastal aquifers and deltas shrink. The degradation of freshwater and marine environments directly impacts ecosystem services and the livelihoods of all of those who depend upon them. Source-to-sea (S2S) management provides a framework to respond to these interconnected environmental challenges with more systematic solutions.

UNLOCK OUR UNDERSTANDING OF S2S LINKAGES

S2S challenges vary widely across geographies, land uses, climates, and socio-economic conditions, but we can categorize these around six priority flows: water, sediment, pollutants, materials, biota, and ecosystem services. Each flow encompassed in S2S management is complex in and of itself, making it challenging to fully understand, predict, and manage the dynamic interactions between them.

We must systematically learn-from-doing to link science to management within, and across,

Volunteers picking up plastic trash. © Freepik.

Human activities impose a heavy burden on land, freshwater, coastal, and marine ecosystems.

S2S intervention strategies must consider the needs of stakeholders and governance context to address location-specific challenges related to the priority flows.

Case study location	Priority flows from "sources"	Downstream "sea" degradation	Natural and engineered interventions	Authors
Lake Hawassa Basin in Ethiopia	Sediment from agricultural lands and Hawassa City	Sedimentation and ecological degradation in Lake Hawassa	- Wetlands - Bench terracing - Farming and grazing restrictions on steep lands	Belete, Hebart-Coleman, Mathews & Zazu
Bohai catchment, China and Baltic Sea catchment, Europe	Nutrients and other pollutants from agricultural lands and wastewater	Eutrophication resulting from excess nutrients flows	- Improved wastewater treatment - Improved fertilizer management - Improved manure and animal waste management	Wang, Lindblom, Zhu, Mathews, Malmaeus & Lei
Danube River Basin and the Black Sea	Nutrients and other pollutants from agricultural lands and wastewater	Massive hypoxia and severe algae growth in the Black Sea.	- Upgrading wastewater treatment plants - Introduction of best available techniques at industrial facilities - Application of phosphate-free detergents - Implementation of best management practices in agriculture	Kovacs & Zavadsky
Australia	Materials - anthropogenic marine debris (AMD) originating from land-based sources	AMD, such as plastics, pose impacts to the environment, fauna, and potentially human health	- Removal of debris from water and vegetation	Clark, Gacutan, Lawther, Johnston, Tait & Bednarz

S2S domains. For example, Zandaryaa and Frank-Kamenetsky analyse the pharmaceuticals in wastewater, sludge, river water, seawater, ocean sediment, and marine biota in the Baltic Sea Region to better understand the transport of emerging pollutants. Dadi et al. generate in-depth knowledge on sediment flows from the upstream basin to Lake Hawassa in the Ethiopian Rift Valley and used this information to identify interventions to reduce sediment flux into the lake. A case study of the S2S system of the Danube River and the Black Sea, provided by Kovacs and Zavadsky, examine factors leading to the reduction of nutrient pollution of the Black Sea over the past decades to help managers keep agriculture loads under control.

These analyses provide key insights and lessons from applied S2S interventions. We can learn from these experiences to start building a robust knowledge base to support the community of practitioners working to manage and sustain the health of our land, water, coastal, and marine systems. For example, Clarke et al. show how learnings from the application of web-based visualization tools in a marine debris database can support environmental research, management, and communications in Australia.

GOVERNANCE STRATEGIES FOR MANAGEMENT ACROSS THE FRESHWATER–MARINE CONTINUUM

Our waters – fresh, coastal, marine, and everything in-between – move across political and disciplinary borders. Further complicating management, a spatial and temporal disconnect exists between the upstream source of degradation and those impacted downstream.

Effectively managing challenges along the S2S continuum requires a multidisciplinary approach that coordinates governance and policy for surface and groundwater, land, coastal, and marine systems at the basin scale and beyond. For example, the International Commission for the Protection of the Danube River (ICPDR) coordinates transboundary cooperation in the Danube Basin and applies legal mechanisms to ensure that surface waters and groundwater within the Basin are managed and used sustainably and equitably. Since the Danube is linked with marine waters by discharging into the Black Sea, the ICPDR also coordinates with the EU Marine Strategy Framework.

■ *Baltic Sea in Gdynia, Pland. © Freepik*

Our waters – fresh, coastal, marine, and everything in-between – move across political and disciplinary borders.

The Great Barrier Reef, Australia.
© Nicolas Weldingh, Unsplash

Existing approaches to water and environmental governance have the potential to support the uptake of S2S management. Noting that common interests tend to require catchment-wide cooperation, such as through Integrated Water Resources Management, Loures highlights ways the community-of-interests doctrine could be applied in support of the sustainable management of transboundary S2S systems. Welling et al. show that multiple existing approaches applied in water and environmental governance have the potential to support the uptake of S2S management. For example, multi-stakeholder platforms can help bring actors together who might not usually exchange and share together, such as representatives of freshwater and marine ecosystems. Opening up dialogues regarding the range of benefits stakeholders receive from a river system can improve the understanding of the impacts of development along the S2S continuum.

The S2S approach continues to evolve through a growing community of practitioners working to manage and sustain the health of our land, water, coastal, and marine systems. Building upon our scientific knowledge of S2S interactions and interventions and appropriately adapting existing water and environmental governance approaches can provide a basis for more effective policies.

BASED ON THE *WATER INTERNATIONAL* SPECIAL ISSUE
Source-to-Sea Management.
46:2. February 2021
www.tandfonline.com/toc/rwin20/46/2

ACKNOWLEDGEMENTS
WI Special Issue Editors: Josh Weinberg, Qinhua Fang, Sarantuyaa Zandaryaa, Greg Leslie and James E. Nickum

IWRA Policy Brief Editor: Kara DiFrancesco

IWRA Policy Briefs Coordinator: James E. Nickum

Layout: Nathalie Lyon-Caen