A CONCEPTUAL FRAMEWORK FOR GOVERNING AND MANAGING KEY FLOWS IN A SOURCE-TO-SEA CONTINUUM

A STAP Advisory Document

STAP SCIENTIFIC AND TECHNICAL ADVISORY PANEL
An independent group of scientists that advises the Global Environment Facility

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The Global Environment Facility (GEF) was established on the eve of the 1992 Rio Earth Summit, to help tackle our planet's most pressing environmental problems. Since then, the GEF has provided $14.5 billion in grants and mobilized $75.4 billion in additional financing for almost 4,000 projects. The GEF has become an international partnership of 183 countries, international institutions, civil society organizations, and the private sector to address global environmental issues. http://www.thegef.org

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FOREWORD

The GEF Vision for 2020 (GEF, 2014) emphasizes the need to support transformational change and achieve environmental and development impacts on a broader scale. It calls for the GEF to address drivers of environmental degradation, facilitate wider coalitions of committed stakeholders and champion innovative and scalable activities. GEF investments remain the largest source of finance *"to promote collective management for transboundary water systems and implementation of the full range of policy, legal, and institutional reforms and investments contributing to sustainable use and maintenance of ecosystem services"* on a global scale. For more than two decades the International Waters (IW) focal area has supported countries working together to secure a wide range of political, economic and environmental benefits from shared surface waters, groundwater and marine systems.

The cross sectoral nature of water resources management, critical to maintaining ecosystem goods and services, link to many of the upstream activities and investments in the other GEF focal areas such as biodiversity, chemicals and waste, land degradation and beyond. It is critical for the GEF partnership to identify a conceptual framework for how these links can function and to design projects that balance competing and expanding uses of water resources for e.g. fisheries, food and energy production while at the same time providing long term benefits to ecosystems and society. Intensification of human activities is leading to a cascade of impacts from land, to coastal zones, to the open sea. Energy production, mineral extraction, and food production are rapidly expanding offshore into the marine environment, where management regimes are often weak or at times non-existent.

This Advisory Document from the Scientific and Technical Advisory Panel (STAP) takes stock of a range of earlier GEF IW investments and concludes that existing governance and management arrangements could be improved to balance the often diverse and conflicting water management objectives, stakeholder priorities, and institutional arrangements of connected systems in the source-to-sea continuum. This proposed source-to-sea framework considers the interconnected social, ecological, and economic systems in a comprehensive manner, from the land area that is drained by a river system to the coastal area to the open ocean it flows into. It offers a way to consolidate analysis, planning, policy-making, and decision-making across sectors and scales. STAP presents in this paper a conceptual framework that can support *the design and implementation* of GEF projects addressing inter-connected upstream and downstream water systems by identifying several key flows that must be managed across the source-to-sea continuum and geographies.

The policy recommendations presented by the STAP are intended to provide guidance as to how the GEF investments can be further scaled up to assist the efforts of countries to address source-to-sea priorities in an integrated way and support the delivery of the 2030 Agenda for Sustainable Development. They have been prepared through a highly consultative process with GEF partners and other stakeholders. We hope the implementation of these recommendations will assist in stimulating future investments addressing environmental issues in the source to sea continuum through improved project design in multi-focal or integrated approach projects in GEF 7 and beyond.

Rosina Bierbaum
STAP Chair

Jakob Granit
Panel Member

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ACRONYMS AND ABBREVIATIONS

ACSLME	Agulhas and Somali Current Large Marine Ecosystems
ADM	Adaptive Delta Management
ALCOSTA	Coalition for the Sustainability of the Gulf of California and the Alliance for the Sustainability of the Northwest Mexican Coastline
BOBLME	The Bay of Bengal Large Marine Ecosystem
BSC	Black Sea Commission
CACILM	Central Asian Countries Initiative for Land Management
CARPHA	Caribbean Public Health Agency
CARICOM	Caribbean Community
CBD	Convention on Biological Diversity
CBSP	Congo Basin Strategic Program
CEP	Caribbean Environment Programme
CMLE	Caribbean Large Marine Ecosystem
CReW	Caribbean Regional Fund for Waste-water Management (GEF project)
CTI	Coral Triangle Initiative
EAF	Ecosystem Approach to Fisheries
EU	European Union
EUSBSR	European Union Strategy for the Baltic Sea Region
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
GWP	Global Water Partnership
HELCOM	Baltic Marine Environment Protection Commission
IADB	Inter-American Development Bank
MENARID	Middle East and North Africa Regional Development
MPAs	Marine Protected Area(s)
MRC	Mekong Regional Commission
MSP	Marine Spatial Planning
NGO	Non-Governmental Organization
PACC	Pacific Adaptation to Climate Change (GEF project)
PEMSEA	Partnerships in Environmental Management for the Seas of East Asia
PCBs	Polychlorinated Biphenyls
REBYC-II LAC	Sustainable Management of Bycatch in Latin America and Caribbean Trawl Fisheries (Gef project)
PFCM	Permanent Framework for Coordination and Monitoring of Water Resources
PROP	Pacific Islands Regional Oceanscape Program (GEF project)
R2R	Ridge-to-Reef
SADC	Southern African Development Community
SAP	Strategic Action Programme
SAPPHIRE	Western Indian Ocean LMEs - Strategic Action Programme Policy Harmonization and Institutional Reforms (GEF project)
SDGs	Sustainable Development Goal(s)
SDS-SEA	Sustainable Development Strategy for the Seas of East Asia
SEI	Stockholm Environment Institute
SFM	Sustainable Forest Management
SIDS	Small Island Developing States
SIRBMP	Sedone Integrated River Basin Management Project (GEF project)
SIWI	Stockholm International Water Institute

IAP	GEF Integrated Approach Pilot
ICARM	Integrated Coastal Area and River Basin Management
ICES	International Council for the Exploration of the Sea
ICM	Integrated Coastal Management
ICPDR	International Commission for the Protection of the Danube River
INRM	Integrated Natural Resources Management
ISPRA	Italian National Institute for Environmental Protection and Research
ITTAS	Iullemeden Taoudeni Tanezrouft Aquifer System
IUCN	International Union for Conservation of Nature and Natural Resources
IWCAM	Integrating Watershed and Coastal Area Management
IWEco	Integrating Water, Land and Ecosystem Management in Caribbean Small Island Developing States (GEF project)
IW:LEARN	International Waters Learning Exchange and Resource Network (GEF project)
IW:LME LEARN	International Waters Learning Exchange and Resource Network for Large Marine Ecosystems (GEF project)
IWRA	International Water Resources Association
IWRM	Integrated Water Resources Management
JAP	Joint Action Programme
LBS	Land-Based Sources of Pollution
LME	Large Marine Ecosystem
LTLT	Lake Tele-Lake Tumba
SLM	Sustainable Land Management
SwAM	Swedish Agency for Marine and Water Management
SWIO-Fish1	First South West Indian Ocean Fisheries Governance and Shared Growth Project (GEF project)
SWIOFP	Southwest Indian Ocean Fisheries Project (GEF project)
TAMP	Transboundary Agro-ecosystem Management Programme
TDA	Transboundary Diagnostic Analysis
TDPS	Titicaca-Desaguadero-Poopo-Salar de Coipasa
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNCSD	United Nations Conference on Sustainable Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNEP-DHI	UNEP-DHI Centre for Water and Environment
UNEP-GPA	Global Programme of Action for the Protection of the Marine Environment from Land-based Activities
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
WIO-LAB	Addressing land-based Activities in the Western Indian Ocean (GEF project)
WIO-SAP	Strategic Action Programme for the Protection of the Western Indian Ocean from Land-based Sources and Activities (GEF project)
WUE	Water Use Efficiency

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EXECUTIVE SUMMARY

AND POLICY RECOMMENDATIONS FOR THE GEF PARTNERSHIP

THE GLOBAL ENVIRONMENTAL CHALLENGE DEFINED

Ecosystems along a continuum from source to sea are being degraded as an unintended consequence of economic activities that might happen far upstream or downstream in the source-to-sea system (Box A). This is partly due to a lack of understanding of how these ecosystems are linked by key flows of water, sediment, pollutants, biota and ecosystem services (Figure A), and partly because existing governance and management arrangements are not well suited to address the flows and ensure sustainability and resilience of the combined source-to-sea systems. These key flows are being constantly altered by the intensification of human activities, which are increasingly expanding offshore where management regimes are typically weak or non-existent. Climate change is also likely to cause further stress in the source-to-sea continuum.

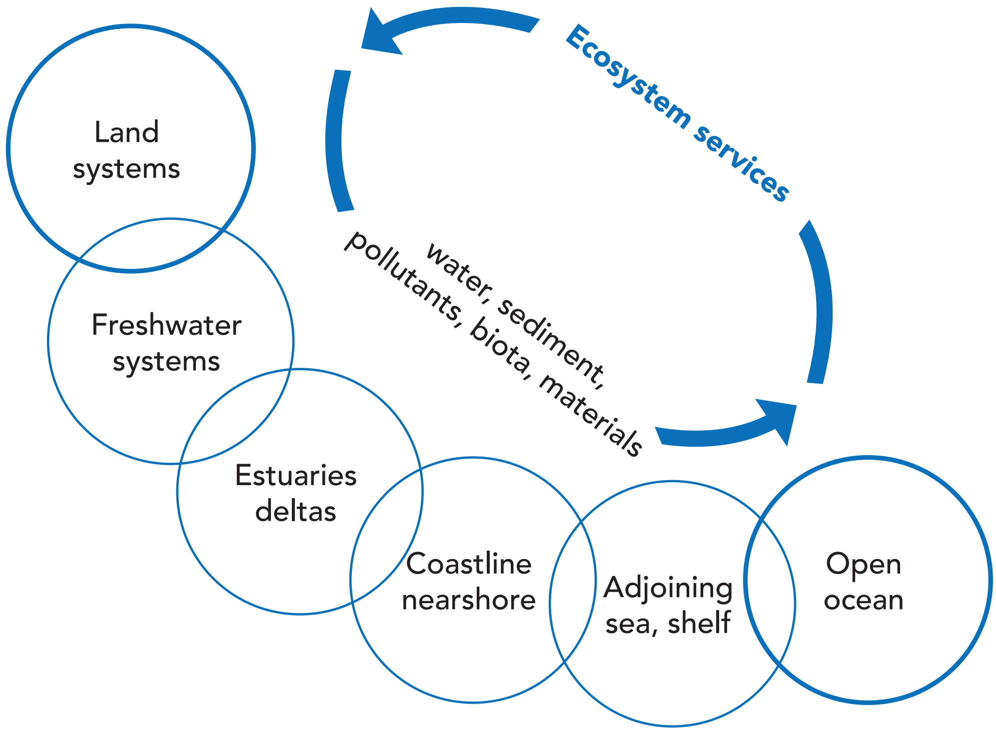
A new comprehensive STAP-commissioned Advisory Document presents a conceptual framework to enhance the understanding of source-to-sea systems that can guide the design of future initiatives aimed at supporting "green" and "blue" growth. The Advisory Document builds on the experiences from the GEF International Waters and multi-focal area projects and programs and other regional initiatives. It includes taxonomy of key flows, identifies the elements to guide an analysis and planning, and a common framework for elaborating a theory of change. Assembling governance baseline and engaging stakeholders are critical elements in the proposed approach. The conceptual framework builds on recent experiences of in source-to-sea systems around the world, and the paper applies the proposed theory of change framework to selected case studies to develop policy recommendations.

BOX A.
What defines a source-to-sea system?

A source-to-sea system includes the land area that is drained by a river system, its lakes and tributaries (the river basin), connected aquifers and downstream recipients including deltas and estuaries, coastlines and near-shore waters, the adjoining sea and continental shelf as well as the open ocean. A source-to-sea system can be defined at a larger scale to include a sea and its entire drainage area, which may include several river basins. Key flows in the form of water, sediment, pollutants, biota, materials and ecosystem services connect the sub-systems in the source-to-sea continuum at different spatial scales.

The Global Environment Facility addresses a range of source-to-sea issues in its extensive portfolio of programs and projects in the International Waters and multi-focal areas. The summary of the Advisory Document points to further opportunities to strengthen source-to-sea linkages and build additional GEF programs and projects in the International Waters portfolio and across focal areas (in multi-focal initiatives) and to promote integrated approaches (IAPs) to achieve global environmental benefits. The conceptual framework presented is an aid to develop operational methods and tools to put source-to-sea governance into practice. It offers a means to account for system linkages in the source-to-sea continuum to achieve the sustainable development aspirations defined in the 2030 Agenda for Sustainable Development and to tackle climate change impacts. Application of the conceptual framework can provide incentives for cooperation within and between countries by identifying options and strategies integrating "green" and "blue" economic growth paradigms.

Figure A. Key flows connecting geographies from source-to-sea: ecosystem services, water, sediment, pollutants, biota and material flows



GEF PORTFOLIO ANALYSIS

A large number of source-to-sea-relevant projects have been approved since 2000 within GEF's focal areas, including a number of multi-focal projects and programs (see Appendices 1 and 2). The successful experience of building multi-country initiatives and institutions puts GEF in a unique position to support source-to-sea initiatives at the transboundary level. A number of lessons are drawn from this review.

SOURCE-TO-SEA LINKAGES

The GEF International Waters portfolio can be divided into projects focusing on river basins, on lake basins, on aquifers and on large marine ecosystems (LMEs), including those addressing primarily fisheries. The portfolio also includes a few projects that look specifically at source-to-sea linkages, through their focus on nutrient reduction measures and/or through their application of the integrated coastal area and river basin management (ICARM) and ridge-to-reef approaches. GEF International Waters projects have adopted the transboundary diagnostic analysis/strategic action programme (TDA/SAP) approach as a strategic planning tool to identify, quantify and prioritize environmental problems that are transboundary in nature (TDA) and, based on this, the formulation of a negotiated policy document establishing clear priorities for action to resolve identified problems (SAP).

While there is a strong focus on pollutants, all of the identified above key source-to-sea flows are targeted to some degree by one or several initiatives in the GEF International Waters portfolio. Source-to-sea-related flows linked to land-based pollution and coastal development/material flows are often identified as priorities in LME interventions. Pollutant, water and (in a few cases) sediment flows are often prioritized by initiatives in river and lake basins and aquifers. However, to date only a handful of river basins, lake basins and aquifer initiatives targeted downstream coastal and environmental improvements in their SAPs: notably in the Danube River, the Volta River and the Rio de la Plata. Priorities related to deltas and estuaries – which fall geographically between river basins and LMEs – are often addressed as part of either transboundary river basin or LME projects and programs, but are rarely a major focus.

The GEF Biodiversity portfolio complements the International Waters portfolio with projects that specifically target seagrass ecosystems (linked to several LMEs), the conservation of wetlands that drain to coastal areas and, to a limited extent, deltas and estuaries.

The GEF Climate Change portfolio offers a range of actual and potential synergies with the International Waters portfolio. Some regional climate change adaptation projects focus on climate adaptation of water resources/river basin management (the Pacific, the Drina River basin, the Andean region), coastal management (West Africa and the Pacific), fisheries (the Caribbean, the Benguela Current) and urban systems (Asia-Pacific).

The GEF Land Degradation and Chemicals and Waste portfolios have stronger thematic links to key source-to-sea flows than geographic links to source-to-sea systems, but there are exceptions, such as projects on land degradation that cover critical water towers; for example the project in the Fouta Djallon, which is the source of both the Senegal and Niger rivers.

The multifocal GEF projects dealing with source-to-sea linkages are often designed to address priorities defined by International Waters initiatives, but have a stronger focus on issues related to natural resource management, biodiversity, persistent contaminants and climate change. From a source-to-sea perspective, there are opportunities to further strengthen links between International Waters initiatives and other GEF focal areas to address priorities in relation to, for example, sediment flows (links with the Land Degradation focal area), pollutant flows (Persistent Organic Pollutants (POPs), Chemicals and Waste), and critical geographies and habitats such as wetlands, deltas and estuaries (Biodiversity).

GEF projects that have a clear geographic link to a particular source-to-sea system can be grouped into three main categories[1]:

1. **Systems where initial regional investment has been made in the form of foundational TDA/SAP projects** (such as in the Humboldt Current and the Bay of Bengal). In these systems the conceptual framework could, where applicable, assist to further identify and prioritize critical source-to-sea flows possibly not considered. This can broaden the scope of the initiatives, scale up additional investments to prevent further damage to critical ecosystems due to source-to-sea connections and enhance the co-ordination of multiple management approaches across the segments.
2. **Systems where the GEF supports activities in both LMEs and river basins**, in some cases through several focal areas. In many systems, source-to-sea priorities have been identified providing good opportunities to further strengthen source-to-sea approaches in future investments. For example there are opportunities to link LME projects such as those on the Guinea Current, the Benguela Current and the Canary Current more strongly with projects in adjacent river basins, in order to improve targeting of critical source-to-sea flows; and
3. **Systems that have received several phases of LME and/or river basin investment** and where strong source-to-sea priorities have been identified and addressed (e.g. the Black Sea, the Baltic Sea, the Patagonian Shelf, the East Asian Seas, the Mediterranean, the Caribbean, and Pacific SIDS). In several of these initiatives, the GEF has adopted a programmatic regional approach, including a range of projects at regional and national levels contributing towards the same objectives. In the cases where key priorities have been identified in relation to pollutant flows, GEF investments have been complemented by funds for pollution reduction. These projects provide an opportunity for learning about operational methodologies on how to address source-to-sea linkages and building sustainability.

KEY FACTORS TO BUILDING SUSTAINABILITY

The case studies of source-to-sea initiatives (see Appendix 3) highlighted the following key factors when seeking to build sustainability in source-to-sea systems:

- **Assembling enabling conditions remains a key challenge in many source-to-sea systems, even after decades of transboundary collaboration.** Challenges related to limited coordination between the governance and management mechanisms responsible for different segments of a source-to-sea system are compounded by sector-driven planning, management and legislative frameworks and challenges in actively involving resource use sectors and other key stakeholders in the source-to-sea system. It takes a long period of sustained effort and investment to instigate and subsequently mainstream practices that could operationalize a source-to-sea approach.
- **Instigating behavioral change among resource use sectors that fall outside the direct sphere of influence of an initiative and those located upstream from a targeted area is a critical concern.** Among the cases reviewed, progress towards the

1 Limited to an analysis of full-sized projects approved since 2000 (see Appendix 2).

desired environmental and societal targets has often been hampered by challenges in involving key resource use sectors and upstream municipalities. The GEF has developed a rich body of experience on the challenges of developing sustainable transboundary institutional mechanisms and inter-ministerial committees at the national level with high-level participation of all relevant sectors.

- **Failure to effectively address source-to-sea key flows can be a major impediment to reaching agreed societal and environmental targets.** The review shows that early recognition of source-to-sea linkages in combination with strategic and concerted effort and investment usually leads to positive results.
- **Achieving positive societal and environmental outcomes in a source-to-sea system demands long-term commitment and acceptance that progress is likely to be incremental.** While demonstration projects, usually at a small geographic scale or targeting a single activity, may produce positive outcomes within a few years, achieving changes in how resources such as water are utilized at the source-to-sea system scale requires several phases of sustained, and adaptive, governance. Strategic approaches are needed to prioritize actions that strengthen weak links in the existing enabling conditions, target objectives that build on existing strengths, and showcase the benefits of collaborative action. Successful programs, as illustrated by PEMSEA, show incremental strengthening in the enabling conditions in the geographic areas addressed, including an expansion in the scope of the program as it builds towards a more inclusive source-to-sea agenda.

A CONCEPTUAL FRAMEWORK FOR GOVERNING AND MANAGING KEY FLOWS IN A SOURCE-TO-SEA CONTINUUM

The Advisory Document proposes a conceptual framework for understanding source-to-sea systems based on the connection of different geographical segments in the system through key flows. The framework can also be used in designing the course of action to improve the condition of source-to-sea systems, by reducing flows that are detrimental to the ecosystem health and by enhancing positive flows of ecosystem services. The conceptual framework is built around a robust theory of change that supports aspirations of the 2030 Agenda for Sustainable Development. This approach builds on earlier work spearheaded by the GEF to identify and respond to system connections from land to sea. In a TDA/SAP process, which is applied by GEF International Waters projects, the conceptual framework can assist in strengthening the analysis of linkages between the targeted water systems and adjacent geographical segments and guide the development of a Strategic Action Programme (SAP) to address prioritized in the TDA source-to-sea issues. The conceptual framework includes the following elements:

- Characterization of a source-to-sea system, which considers the interconnectedness of key flows in the continuum and identification of segment-specific and source-to-sea systemic issues.
- Thorough analysis of governance by developing a governance baseline defined by the capacity of the past and existing governance and management systems to consider priority issues in the source-to-sea continuum.
- Definition of an appropriate scale for the analysis in the particular source-to-sea system (Figure B). The scale can vary from one or more closely connected segments to a river basin and downstream recipient, a sea and its drainage area all the way to global system linkages.
- Engagement of key stakeholders from different sectors and domains of the source-to-sea system involved in prioritization, design and implementation.
- The application of theory of change to guide governance and management responses in the long-term and track the progress towards achieving agreed goals and positive changes in societal, economic and environmental conditions in the continuum. The paper proposes a framework for developing such a theory of change, which disaggregates the ultimate goal of sustainable development supporting the integrated "green" and "blue" growth agenda into four orders of measurable outcomes (Figure C).

Figure B. Source-to-sea linkages and the need for governance and management responses at different scales

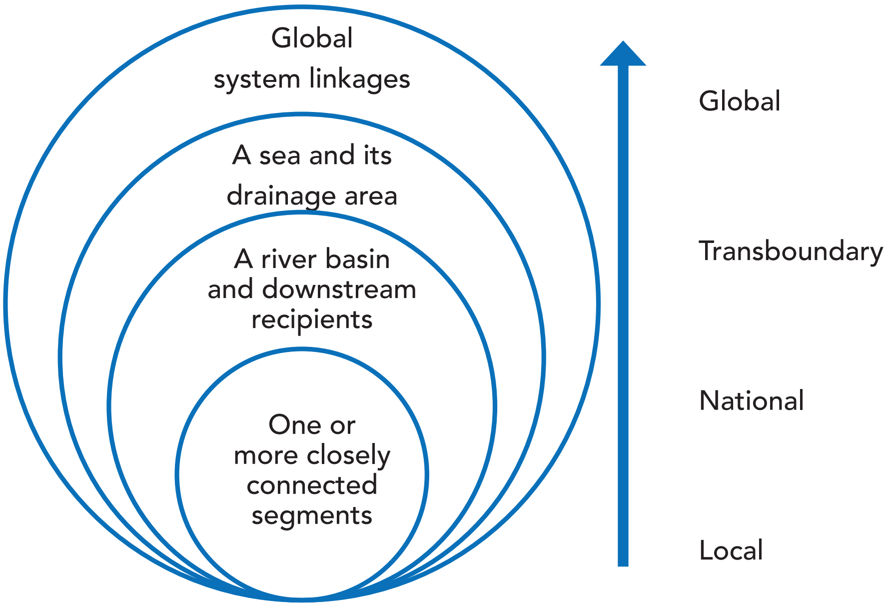
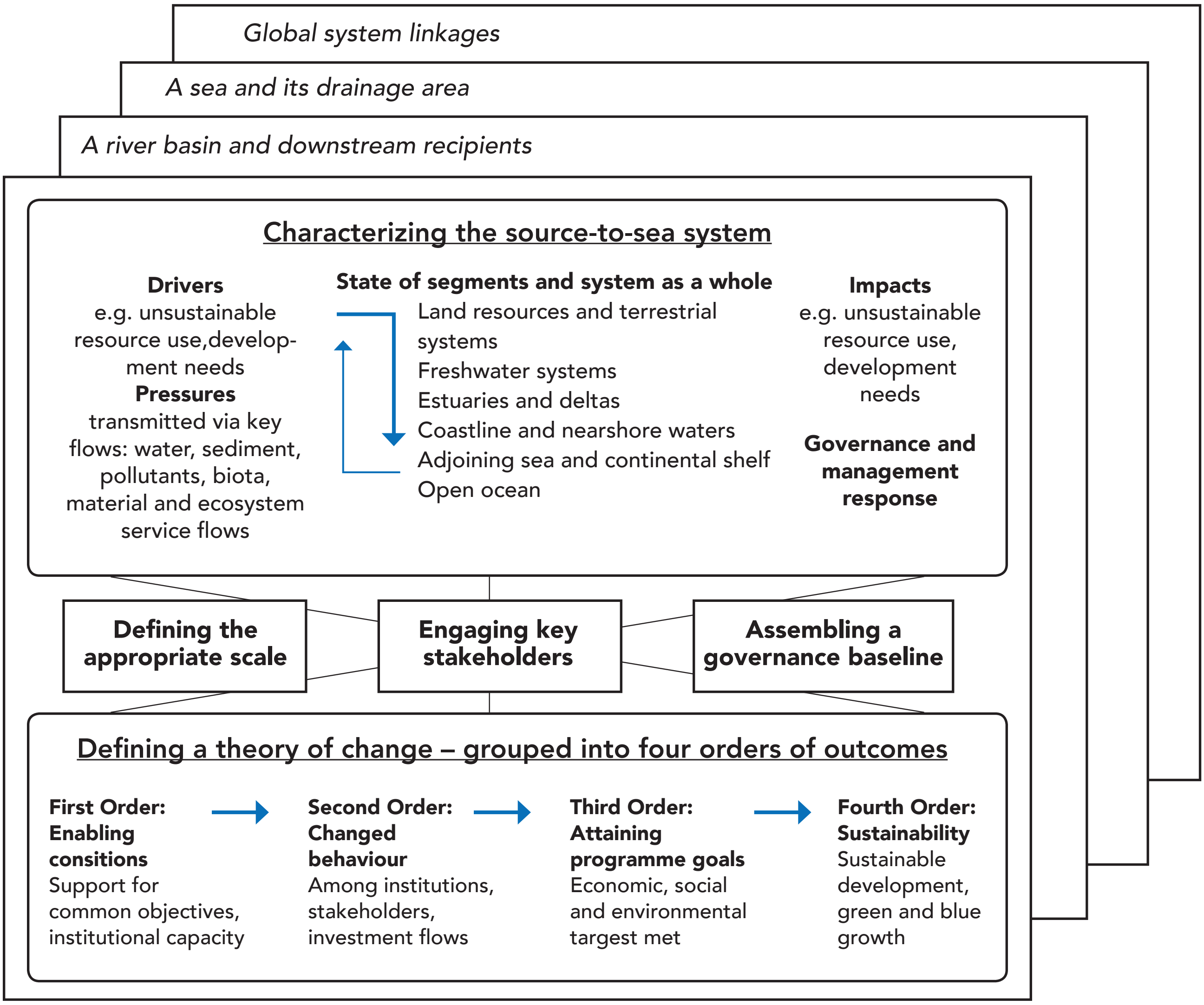


Figure C. A source-to-sea conceptual framework



RECOMMENDATIONS FOR THE GEF PARTNERSHIP

The degradation of ecosystems along a continuum from source to sea represents a major development challenge and demonstrates a lack of understanding of the opportunity costs of neglecting system linkages. Globally, the GEF partnership is among few actors supporting projects and programs throughout a source-to-sea continuum. The GEF strives to utilize its resources and network to introduce innovation in the design of programs and policies. The sustained investment by the GEF partnership in international waters and other focal areas over the last 25 years provided a unique knowledge base on development challenges and addressed by the 2030 Agenda for Sustainable Development.

The ultimate goal of the STAP Advisory Document is to present foundations for the integrated "blue" and "green" economic growth opportunities in the source-to-sea continuum. STAP's recommendations to the GEF Partnership are intended to identify opportunities to further scale up investments to address source-to-sea priorities throughout the GEF portfolio.

These recommendations have been developed through a consultative process with multiple stakeholders representing the GEF family and beyond including GEF partner agencies, countries and learning networks such as the Action Platform on Source to Sea Management. The recommendations aimed at the GEF recipient countries and agencies as well as the GEF Secretariat as follows:

1. **Ensure that the strategies and course of action are informed by a thorough understanding of the governance dimensions of a given source-to-sea system.** Governance arrangements in the source-to-sea systems are complex. A detailed and sophisticated analysis of the existing governance system, how it has evolved over time, and what are its strengths and weaknesses is needed. A comprehensive governance baseline assessment in the source-to-sea continuum should complement the governance analysis undertaken as a part of a TDA (in the case of GEF International Waters projects). Strategic planning should focus on improving coordination and collaboration within the current governance framework, rather than proposing a new framework.

2. **Key stakeholders and resource-use ministries from the different segments of the source-to-sea system should be engaged early in planning processes.** This could contribute to stronger program design, increased commitment among key stakeholder groups towards the required actions, and a culture of stewardship rather than merely promoting technical solutions to social and environmental problems and drivers of change. Access to data and information on the extent, causes and implications of environmental deterioration in the source-to-sea continuum remains a critical aspect to enhance the engagement of stakeholders in planning processes, to provide incentives for collaboration between different actors and to enable the identification of sustainable development options.

3. **Systematic consideration should be given to key source-to-sea flows in the development and update of the GEF-supported TDAs and SAPs.** GEF International Waters projects in both freshwater systems and LMEs already define key source-to-sea related issues and identify actions and stakeholders to address them through the TDA/SAP approach. However, the projects generally have a very broad thematic focus not addressing complex upstream–downstream connections. Fewer strategic interventions with a greater likelihood of changing the status of critical source-to-sea segments can sometimes be more effective in delivering global environmental benefits in the medium term. In the SAP implementation phase, greater emphasis could be placed on managing key source-to-sea flows through strategic interventions (focusing on the most important flows) beyond often narrow focus of pollution-reduction components of the SAPs. An opportunity exists to develop guidance on source-to-sea mainstreaming in the TDA/SAP process as a part of the IW:LEARN and IW:LME LEARN projects.

4. **Capitalize on the existing thematic and geographic linkages between the different GEF focal areas in source-to-sea systems.** Multifocal projects are already the norm in SAP implementation projects in both LMEs and freshwater systems. However, there are opportunities to further strengthen linkages between the different GEF focal areas to address specific source-to-sea flows. Examples include flows of biota (such as fish migrating from coastal areas to rivers); flows of sediment created by land degradation in upstream areas to downstream and coastal areas; pollutant flows from agricultural and industrial sources in catchments draining into sensitive

coastal environments; and flows of solid waste in river basins that ultimately reach the open ocean as marine litter. A source-to-sea approach would enable better targeting of focal area funding within a broader multi-focal SAP by linking GEF interventions to achieve impact at scale. Strengthening multifocal approaches also requires harmonization or better alignment of management approaches along the source-to-sea continuum, such as between Integrated Coastal Management (ICM), Integrated Water Resources Management (IWRM), Sustainable Land Management (SLM), Marine Spatial Planning (MSP) and others. Some progress in management framework integration has already been made in regions such as the Caribbean and in the East Asian Seas and has to be extended to other regions. However, further guidance on how to link these management approaches in the source-to-sea continuum along with development of tools that could be applied across the GEF portfolio.

5. **Apply a robust, coherent theory of change for source-to-sea systems across segments of the continuum in GEF projects and programs.** A theory of change for a source-to-sea system would help identifying the combination of strategic interventions that are most likely to catalyze progress towards the desired environmental and societal targets at different spatial scales in the continuum. A robust theory of change could help to identify and negotiate potential trade-offs while optimizing "green" and "blue" growth opportunities. It could also facilitate assessment of progress towards achieving environmental outcomes and social impacts. Collaborative learning between source-to-sea initiatives also benefits when programs are designed, implemented, monitored and evaluated in relation to a common theory of change, which can also guide self-assessment by individual programs and promote adaptive management. A possible outline structure for a theory of change is presented in the Advisory Document. It has the advantage of being relatively simple, and can be used with generic indicators, making it likely to be readily understood by a diversity of stakeholders, from fisherfolk and farmers to academics and policy-makers.

6. **Develop an integrated approach pilot (IAP) to inform how the GEF can better address source-to-sea linkages across its project portfolio.** Stronger collaboration could be harnessed between GEF agencies and focal areas in source-to-sea systems, by building on progress already made in International Waters interventions in river basins, aquifers and LMEs, applying a common theory of change in a larger integrated program with common goals. Source-to-sea systems with the existing past GEF experience with TDAs/SAPs could be targeted first, while lessons can be learned from successful multi-phase programs like those of PEMSEA, Danube/Black Sea and the Baltic Sea. A priority should be to establish linkages between GEF-supported LME projects and GEF support to adjacent river basin management projects in a larger geography, such as in West Africa. At the TDA/SAP development phase, focus should be on identifying critical source-to-sea flows that bridge these systems and on identifying governance arrangements that enhance coordination and collaboration between upstream and downstream segments, including understanding the drivers of social change. There is an opportunity to build on GEF's pilot IAPs (Sustainable Cities, Taking Deforestation out of Global Commodity Supply Chains and Sustainability and Resilience for Food Security in Sub-Saharan Africa) and construct an IAP framework of analysis based around the source-to-sea conceptual framework.

7. **Invest in knowledge generation and exchange to speed up learning to address critical source-to-sea flows across the wider GEF portfolio.** The review of case studies in the Advisory Document shows that it often takes decades to understand and begin to address source-to-sea system degradation in a concerted manner. Global environmental benefits are seldom seen in source-to-sea systems in the near term. More knowledge is needed to help design better interventions and to increase the efficiency and effectiveness of initiatives that aim to build sustainability in these systems. Further cross-portfolio analysis should analyze the specific actions that would strengthen GEF investments in the source-to-sea continuum. To fully realize the opportunities for integration in the GEF portfolio, methods and tools need to be developed for identifying and managing critical source-to-sea flows and their impacts on the different geographical segments of the source-to-sea system. Areas in need of further guidance include the harmonization of management approaches and the development cross-cutting indicators and targets for impacts of interventions across source-to-sea segments; and the integration of analysis of source-to-sea flows in TDA/SAP processes, including updating the methodology and the standard module.

INTRODUCTION

1

The degradation of ecosystems along a continuum from source to sea demonstrates a lack of understanding of the costs of neglecting system linkages. A source-to-sea system includes the land area that is drained by a river system to the open ocean, with the different subsystems connected by a variety of flows (see Box 1). Because of these connections, the intensification of human activities to meet societal demands, both upstream and midstream, can lead to a cascade of impacts on ecosystems that extend down to coastal zones and to the open sea. Yet existing governance and management arrangements face significant challenges in addressing such system connections. In parallel, anthropogenic alterations and activities such as energy production, mineral extraction and food production are expanding offshore into the marine environment, where management regimes are typically weak or even non-existent.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This paper proposes a conceptual framework for understanding source-to-sea systems, based on the connection of different geographical segments in the system through key flows, and for designing courses of action to improve the condition of source-to-sea system, by breaking flows that are detrimental to the broader ecosystem and by enhancing positive ecosystem service flows. A critical part of the conceptual framework is a theory of change for advancing sustainability by applying a source-to-sea lens to development and management in the defined system. This approach builds on earlier work to identify and respond to system connections from land to sea.

The source-to-sea conceptual framework offers one way to tackle the development aspirations defined in the new 2030 global sustainable development agenda (UNGA, 2015) at a source-to-sea system scale, recognizing the need to treat the Sustainable Development Goals as integrated and indivisible, balancing complex economic, social and environmental dimensions of sustainable development (the "triple bottom line").

BOX 1.
What defines a source-to-sea system?

A source-to-sea system includes the land area that is drained by a river system, its lakes and tributaries (the river basin), connected aquifers and downstream recipients including deltas and estuaries, coastlines and near-shore waters, the adjoining sea and continental shelf as well as the open ocean. A source-to-sea system can be defined at a larger scale to include a sea and its entire drainage area, which may include several river basins. Key flows in the form of water, sediment, pollutants, biota, materials and ecosystem services connect the sub-systems in the source-to-sea continuum at different spatial scales.

1.1. METHODS

In this study we use a combination of analytical methods. A literature review helped to identify the challenges that have emerged in source-to-sea systems and illustrate the pressures and impacts that human activities can generate in different geographical segments of a system and their consequences for the system as a whole. The theoretical framework applied rests on an understanding of the earth as an integrated system, as developed in research on key earth system processes (Bretherton, 1988; Steffen *et al., 2004)*, social-ecological systems (Berkes *et al.*, 2003; Berkes and Folke, 2002), and balancing socio-economic development with environmental conservation in order to achieve sustainable development (Clark and Munn, 1986; UNFCCC, 2015; UNGA, 2015; UNWCED, 1987). Theories of "green" and "blue" economic development (UNCSD, 2012a; UNEP, 2011) – identifying economic growth sectors with the potential to reinforce environmental sustainability in general (green) and in coastal and marine areas in particular (blue) – were used to demonstrate opportunities for sustainable economic growth across interconnected source-to-sea systems.

We used the Orders of Outcomes framework (Olsen, 2003; Olsen *et al.*, 1999; UNEP-GPA, 2006) as the basis for a theory of change for achieving greater long-term sustainability through coordinated governance of source-to-sea systems. Central to this theory of change is the distinction between governance and management drawn by Olsen (2003) and Olsen *et al.* (2009) whereby governance concerns the fundamental goals, institutional processes and structures that are the basis for planning and decision-making and sets the stage on which management occurs, while management is the process by which human and material resources are harnessed to achieve a defined goal within a defined institutional structure.

Experience-based findings were generated through an assessment of linkages in projects and programmes addressing source-to-sea priorities. This includes an in-depth analysis of a selection of Global Environment Facility (GEF) supported projects across focal areas and other international cases (Appendices 2 and 3). These cases are reproduced in Appendix 3 and include initiatives in the Seas of East Asia; the Bay of Bengal; the Danube River and the Black Sea; Caribbean Small Island Developing States (SIDS); the Colorado River, its delta and the Gulf of California; and the Baltic Sea.

To test the early results and findings of this study, consultations were undertaken on four occasions. These consultations included a peer review process involving a wide range of actors with large collective experience from the science, governance and management of source-to-sea systems globally, including members of the Action Platform on Source to Sea Management.[2]

2 Current member organizations of the Action Platform on Source to Sea Management (www.siwi.org/source-to-sea) include: the Benguela Current Commission, Delta Alliance International, the Food and Agricultural Organization of the United Nations (FAO), the Secretariat of the GEF, the Global Water Partnership (GWP), the International Commission for the Protection of the Danube River (ICPDR), the International Union for the Conservation of Nature (IUCN), the International Water Resources Association (IWRA), the Italian National Institute for Environmental Protection and Research (ISPRA), Race for the Baltic – Zennström Philanthropies, the Ramsar Convention, Stockholm Environment Institute (SEI), Stockholm International Water Institute (SIWI), the United Nations Development Programme (UNDP), the United Nations Environment Programme Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (UNEP-GPA), the UNEP Centre on Water and Environment (UNEP-DHI), the Water-Culture Institute, Wetlands International and Xiamen University.

2

CURRENT CHALLENGES,

GOVERNANCE AND MANAGEMENT RESPONSES IN THE SOURCE-TO-SEA CONTINUUM

This chapter describes the current environmental pressures and challenges in source-to-sea systems, and how relevant global governance and management responses have evolved to support greater sustainability in the source-to-sea continuum.

2.1. ENVIRONMENTAL PRESSURES

Crutzen (2002) asserts that we have entered a new geological era, the Anthropocene, in which human actions have significant impacts on earth system processes. Since the 1950s, the world has experienced a period of rapid intensification in human enterprise, dubbed "the Great Acceleration" (Steffen *et al.*, 2007), during which global population, gross domestic product and urban populations have increased exponentially (Steffen *et al.*, 2007, 2015). Ecosystems have largely been able to meet the growing demands for food, thanks to advances in irrigation and fertilizer use, and human well-being has improved through the management of water use, flood control, irrigation, hydropower and pollution control (MA, 2005).

However, many natural resources are now over-exploited or on the verge of over-exploitation (Bierbaum *et al.*, 2014; Gleeson *et al.*, 2012; Nilsson *et al.*, 2005; UNEP and UNEP-DHI, 2016; Vörösmarty *et al.*, 2010; World Bank, 2013, p. 201; WWAP and UN-Water, 2014) and projections suggest resource use will continue to grow in coming decades. By 2050, in a business-as-usual scenario, the global human demand for water is expected to increase by 55 percent (OECD, 2012), demand for food by 70–100 percent (World Bank, 2007), and demand for energy by 37 percent (OECD/IEA, 2014). If today's urbanization trends continue, most of the estimated additional 2–3 billion people living on the planet in 2050 will reside in urban areas and in coastal zones (McGranahan *et al.*, 2007; UNDESA, 2015). At the same time, projected impacts of climate change are likely to affect supply and demand of water resources and all aspects of food security (IPCC, 2014).

These drivers are clearly visible in source-to-sea systems. WWF (2014) reports that freshwater biodiversity has declined by 76 percent globally over the past 40 years. Over the same period, 64–71 percent of the world's wetlands have disappeared (Davidson, 2014). Hydraulic infrastructure has, according to Nilsson *et al.* (2005), resulted in over half of the world's major rivers being severely affected by the alteration and fragmentation of their flow regimes. Similarly, 20 percent of the world's groundwater aquifers are reportedly overexploited (Gleeson *et al.*, 2012).

The intensification of human settlement in coastal areas puts significant pressure on coastal ecosystems (Murray *et al.*, 2014), for example through habitat destruction, land drainage and land reclamation, alteration of run-off patterns, and increasing pollution loads. The world's deltas are often densely populated and intensively farmed. They are increasingly vulnerable to flooding and submergence through the combined effects of the trapping of sediment behind dams and sea-level rise due to climate change (Syvitski *et al.*, 2009), and in some cases over-abstraction of groundwater (Erban *et al.*, 2014).

The world's marine areas are similarly affected by human change. Halpern *et al.* (2008) assert that virtually none of the world's marine areas are today unaffected by human influence and that the largest impacts are felt in those areas subject to both land-based and marine-based human pressures. The excessive loading of nutrients in marine and coastal areas is a major pollution problem globally (Howarth *et al.*, 2002) and the resulting eutrophication is one of the leading causes of degradation of marine waters and deoxygenation in parts the of open oceans. In addition, increasing absorption of carbon dioxide and various pollutants is further changing the chemistry of the oceans and contributing to their acidification. The global spread of industrial pollutants such as mercury and persistent organic pollutants (Doney, 2010), and the increasing abundance of microplastics and other marine litter (GESAMP, 2015; Law and Thompson, 2014), put severe stress on open ocean ecosystems.

There is a growing understanding that "the Earth behaves as a system in which oceans, atmosphere and land, and the living and non-living parts therein, are all connected," (Steffen *et al.*, 2004) and that "fragmentary approaches focusing on parts of the Earth system . . . invariably in the long-term fail to be sustainable" (Bierbaum *et al.*, 2014). The continuous circulation of water ties together the Earth's lands, oceans and atmosphere into an integrated system crossing political jurisdictions.

Nevertheless, challenges remain in addressing linkages within the system and preventing unintended negative outcomes from interventions in the source-to-sea continuum. The current governance and management arrangements are poorly suited to balancing the diverse and often conflicting management objectives, stakeholder priorities and institutional arrangements in different geographical segments of source-to-sea systems. Instead, issues tend to be dealt with segment by segment or sector by sector, aiming for outcomes that may or may not be optimal for the system as a whole.

2.2. SUSTAINABLE DEVELOPMENT IN THE CONTINUUM

Even as human activities put increasing pressure on natural ecosystems and resources, there has been significant progress in understanding both the value and the vulnerability of natural ecosystems. Technological and management approaches to enable more sustainable use of natural resources have been developed and tested throughout the source-to-sea continuum.

The ecological compensation scheme established in Xiamen, China, to finance pollution-reduction measures by upstream cities in order to protect the Jiulong River and Xiamen Seas is one example of how properly valuing downstream resources can generate financing for green investments upstream (Lundqvist *et al.*, 2013). The virtual elimination of the 40,000 km2 hypoxic zone in the Black Sea through policy and regulatory reforms and US$3 billion in nutrient-reduction investments (ICPDR, 2007) shows that early recognition of source-to-sea linkages and concerted effort can reverse negative trends in ecosystem impact. Initiatives such as these have often come about after catastrophic environmental deterioration has driven governments to prioritize remediation.

Investments in sectors where economic growth and environmental sustainability are mutually reinforcing are increasingly seen as ways to contribute to a sustainable development and to advance a green or blue economy. The UN Environment Programme (UNEP, 2011) defines the "green economy" as an economy that "results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities". Opportunities to be more resource-efficient in sectors such as agriculture, energy and transport, renewable energy, and solid waste and wastewater recycling are now being identified by governments worldwide (National People's Congress, 2011; OECD, 2009; SRV, 2012). The water–food–energy nexus (Hoff, 2011) is an example of a useful conceptual framework for action towards a green economy – tackling interdependencies between key sectors; determining and

resolving trade-offs between increasing demands; and achieving water, energy and food security without compromising sustainability.

The concept of the blue economy has developed alongside the green economy. It implies the need to consider the economic benefits generated by coasts and oceans in all aspects of economic activity (UNCSD, 2012a). A growing number of national and regional initiatives are being implemented to develop marine sectors while investing in research and governance to support a more sustainable balance between economic exploitation and environmental sustainability (EC, 2012; National People's Congress, 2011; Zuma, 2014).

Technological developments have opened up new opportunities for exploitation of marine areas. However, the economic growth potential of coastal and marine areas depends to a large extent on their environmental conditions, which are strongly influenced by activities upstream in the source-to-sea continuum.

Hoegh-Guldberg *et al.* (2015) assert that more than two-thirds of the estimated annual economic value of the oceans of at least US$2.5 trillion depends on healthy ocean ecosystems. Development activities downstream are linked to upstream change.

Remedying environmental degradation can cost governments billions of dollars and take decades of sustained effort (Bay Restoration Fund, 2004; IBWC, 2012; MDBA, 2012; UNDP, 2012). Sustaining blue economic growth and balancing it with upstream development priorities requires governance and management processes that are able to balance user needs in source-to-sea systems as a whole. Sweden has attempted to address this need by giving responsibility for both marine and freshwater management to the newly created Swedish Agency for Marine and Water Management (SwAM), described in Box 2.

BOX 2.
A management innovation – the Swedish Agency for Marine and Water Management

In Sweden, recognition that water represents a coherent terrestrial–coastal–marine system led to the establishment of a Swedish Agency for Marine and Water Management (Government of Sweden, 2010). The agency began its operations in 2011, merging the main parts of the Swedish Board of Fisheries, which then closed, and parts of the Swedish Environmental Protection Agency. Gathering the main responsibilities for marine and water management under one roof encourages government, authorities and society to take a more holistic view of environmental problems and challenges in the source-to-sea continuum. However, after only four years of operation, SwAM still faces challenges; in particular in relation to integrated management of land-based activities that impact on water and marine resources, which is crucial for achieving good status in Swedish water environments.

2.3. POLICY FOUNDATIONS

The governance and management of source-to-sea systems require planning, policy-making and decision-making at several spatial scales. This section outlines current policy foundations for the planning and coordination of activities in the source-to-sea continuum. In recent decades, the international community has committed to goals designed to slow environmental degradation and to move towards more sustainable development. These commitments set the context for the source-to-sea conceptual framework proposed in this paper.

Governance

Global commitments in the multilateral system have over time underlined the important links between systems within the source-to-sea continuum from different perspectives. With Agenda 21, the 1992 United Nations Conference on Environment and Development (UNCED) established sustainable development as a common global priority and identified integrated approaches to the management of natural resources as a means to achieve it (UNCED, 1992). Compartmentalized development planning with an engineering-dominated approach began to give way to more cross-sectoral planning with a focus on participation and integration (Granit *et al.*, 2014). The UN Environment Programme Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (UNEP-GPA), adopted in 1995, called for integrated management of coastal areas and river basins. In 2012, representatives of 64 countries followed up on this by recognizing the need to "improve cooperation and coordination at all levels to deal with issues related to oceans, coasts, islands and their associated watersheds by applying integrated management approaches, such as the 'ridge to reef' concept . . ." (UNEP-GPA, 2012).

The ecosystem approach to governing land resources emerged in the 1980s and 1990s in response to the deepening biodiversity crisis, and attracted increasing interest also in the marine space due to the declining state of fisheries and ocean ecosystems. In 1995, the Conference of the Parties to the Convention on Biological Diversity (CBD) adopted the ecosystem approach as the primary framework for action under the Convention (CBD, 1995), which was later defined as "a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way" (CBD, 2000).

In 1997, the UN Commission on Sustainable Development (UNCSD) found that "the concept of integrated management of watersheds, river basins, estuaries and marine and coastal areas is now largely accepted in the United Nations system and in most countries as providing a comprehensive ecosystem-based approach to sustainable development" (UNCSD, 1997). This approach to governance was reinforced in 2010 when world leaders met at a Conference of the Parties to the CBD and adopted the Aichi biodiversity targets (CBD, 2010a). These targets are to be achieved by 2020 and include measures to safeguard both terrestrial and inland waters and coastal and marine areas and to reduce what had been identified as the principal pressures on biodiversity (CBD, 2010b). Many of the targets relate to pressures on downstream ecosystems from upstream development, notably in the forms of pollution and habitat degradation and fragmentation. Goals related to the sustainable management of natural resources upstream are highly relevant to source-to-sea systems.

With strong support from the UN Convention to Combat Desertification (UNCCD), an aspirational goal of a "land-degradation-neutral world in the context of sustainable development" was approved in 2012 as part of the Rio+20 process (UNCCD, 2012; UNCSD, 2012b). This goal is to be achieved by managing land more sustainably, and increasing the rate of restoration of degraded land. This has strong links to management of soil erosion and sediment flows in source-to-sea systems.

The governance framework relevant for source-to-sea systems also includes commitments to address climate change and its impacts. In December 2015, the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) adopted the Paris Agreement, committing the international community to limit global warming to well below 2°C. This includes a goal of mobilizing US$100 million per year in support of climate change adaptation in coastal areas and climate change mitigation through, among other things, the sustainable forest management (see below) approach (UNFCCC, 2015).

Governance principles creating the foundation for integrated management approaches also feature prominently in the Sustainable Development Goals (SDGs), adopted in September 2015 (UNGA, 2015). Although issues such as food security, sustainable management of water and sanitation, sustainable economic growth, or sustainable use of the oceans and terrestrial ecosystems are dealt with in separate goals and targets, the SDGs are by nature universal, integrated and indivisible, and in several cases their delivery is dependent on addressing pressures in connected systems. As an example, significant reduction of marine pollution (Target 14.1) directly depends on sustainable agriculture (Goal 2), management of water and sanitation (Goal 6), sustainable industrialization (Goal 9), sustainable urban development (Goal 11), and sustainable consumption and production patterns (Goal 12).

Management

Specific management approaches to address resource use in different segments of the source-to-sea continuum have developed independently in different sectors, often with different objectives and modes of operation (Olsen *et al., 2009; Pickaver and Sadacharan, 2007; UNEP-GPA, 2006).* They are all designed to manage highly complex and dynamic systems, but offer limited guidance when dealing with the links between the systems in spite of strong signals from the globally agreed governance

frameworks stressing integration. See Appendix 4 for brief descriptions of the dominant management approaches.

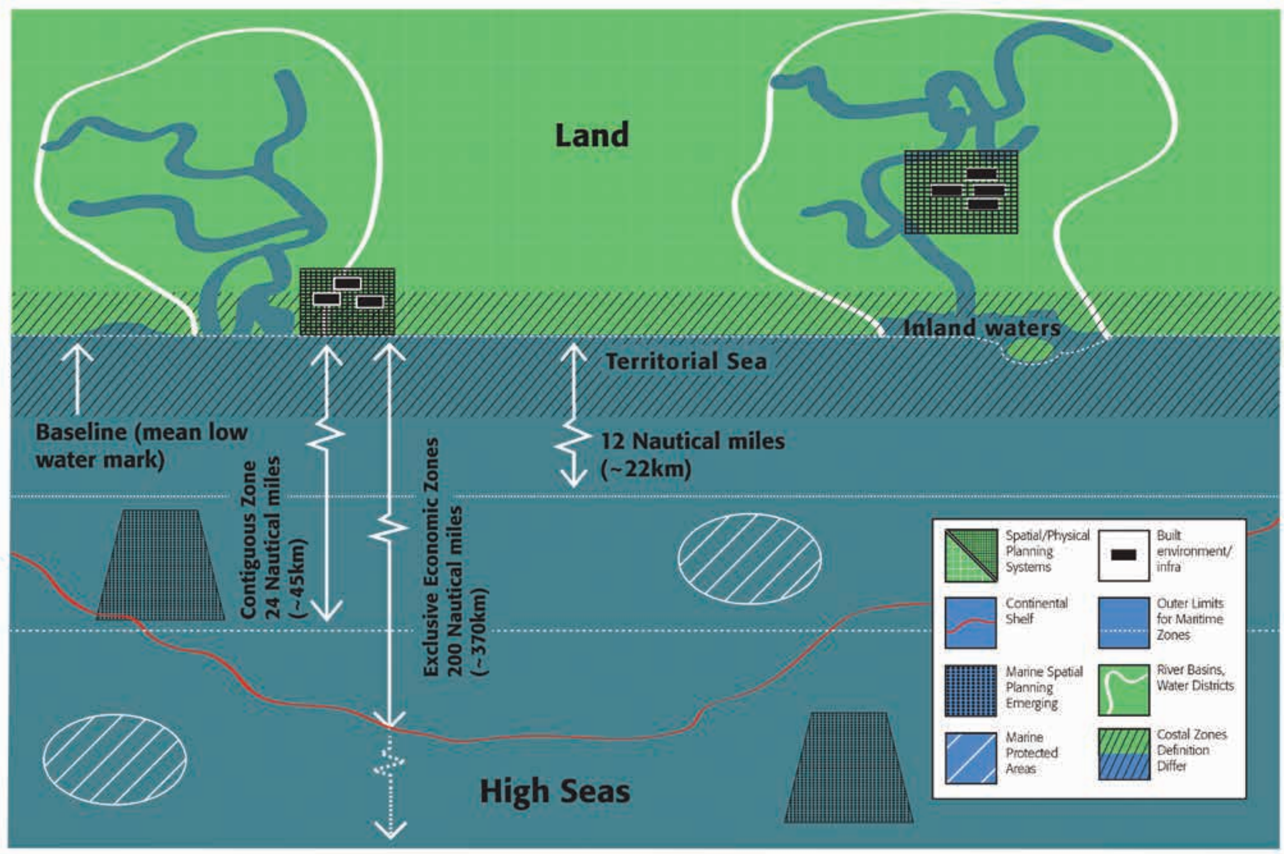
In terrestrial systems, sustainable forest management (SFM) addresses forest degradation and deforestation with the aim to "maintain and enhance the economic, social and environmental value of all types of forests for the benefit of present and future generations" (UNGA, 2008), while sustainable land management (SLM) strives more broadly to enable land users to maximize economic and social benefits from land resources while maintaining or enhancing the ecological support functions they serve (Liniger *et al.*, 2011).

Water resources management takes a river basins approach. The dominant water resources management concept since UNCED 1992 has been integrated water resources management (IWRM), which focuses on the process of allocating water for multiple use (Granit, 2011). In the coastal zone a similar approach to management integration is defined as integrated coastal management (ICM) that deals with multiple-resource and multiple-use management based on physical planning, with a strong emphasis on land-use regulation and physical intervention (Pickaver and Sadacharan, 2007). The ecosystem approach to fisheries (EAF) aims to apply an integrated approach to fisheries management within ecologically meaningful boundaries, balancing diverse societal objectives (FAO, 2003).

The mechanisms to support the delivery of these management approaches include national initiatives and associated national action plans for implementing multilateral environmental agreements such as the UNFCCC, CBD and UNCCD (as in the case of SLM and SFM); national inter-ministerial/cross-sectoral steering committees (as in the case of IWRM); local government coordination (as in the case of ICM); and sectoral management organizations (as in the case of EAF). An important objective of many of these mechanisms is to enable the involvement key resource-use sectors active in the source-to-sea continuum (e.g. forestry, agriculture, energy, industry, fisheries). However, involving sectors that fall outside the responsibility of the government bodies directly involved in applying the relevant management approach in its geographic focus area has often proved challenging.

The need to connect different management approaches in parts of the source-to-sea continuum has been recognized before. An example is integrated coastal area and river basin management (ICARM), which was introduced in 1999 in an attempt to better connect IWRM and ICM (UNEP, 1999).

Figure 1. Overlapping or weak governance and management frameworks in the source-to-sea continuum



Source: Granit et al., 2014.

Substantial efforts, largely driven by the UN Environment Programme (UNEP), have been made to strengthen the knowledge base on ICARM through case studies, pilot projects, guidelines and markers for assessing progress (Olsen *et al.*, 2009; Pickaver and Sadacharan, 2007; UNEP-GPA, 2006). This work has helped to identify a number of common needs for effective implementation of linked management of river basins and coastal zones. These needs include strong and sustained political will in order to tackle the complex administrative organization of freshwater and marine management and the lack of coordination between the institutions concerned; a water policy framework able to harmonize national economic development plans with water sector plans; and regional cooperation on transboundary issues (Pickaver and Sadacharan, 2007).

Meanwhile, an initiative adopting a "ridge-to-reef" approach is currently being initiated in the Pacific SIDS (GEF, 2015; UNDP/GEF, 2013, 2014). There is no unifying framework or agreed definition of the ridge-to-reef approach, but it is based on an understanding of the need to manage river basins and coastal areas (from the ridges at the top of a watershed to coastal coral reefs) as continuums of interconnected human uses and ecosystems. The approach aims to maintain and enhance ecosystem goods and services through integrated approaches to land, water, forest, biodiversity and coastal resource management (UNDP/GEF, 2014).

Over the years, other concepts and tools have emerged as useful complements to the established integrated management approaches in source-to-sea systems. In river basins, the need to maintain certain environmental flows (in terms of the quantity, timing and quality of water flows) to sustain aquatic ecosystem function is becoming well recognized (Brisbane Declaration, 2007; Poff *et al.*, 2010; Poff and Zimmerman, 2010). There are presently several cases where environmental flows are being considered as an integral part of management strategy and decision-making, including in Australia (World Bank, 2009), South Africa (World Bank, 2009), the United States (Poff *et al.*, 2010) and Mexico (Gómez-Balandra *et al.*, 2014).

Building on decades of experience in implementing IWRM, while recognizing the critical situation faced by many deltas, adaptive delta management (ADM) has emerged as an approach to support decision-making in water policy, planning and infrastructure investment (Delta Alliance, 2014). There is also a growing body of guidance and techniques available to increase the sustainability of, for example, dam development (AfDB, 2003; IHA, 2011; Kondolf *et al.*, 2014; Lindström *et al.*, 2012; Richter and Thomas, 2007; World Commission on Dams, 2000); agriculture (DEFRA, 2009; IW:LEARN, 2006); land management (Liniger *et al.*, 2011); forestry (Samuelsson *et al.*, 2015); and industrial practices (SIWI and Sustainability Outlook, 2015).

In coastal and marine areas, the practices of ICM are becoming increasingly adapted to marine spatial planning (CBD and STAP, 2012; Granit *et al., 2014; Olsen et al., 2011)*. Providing an ecosystem- and area-based management framework that addresses multiple management objectives, marine spatial planning has been put forward as one of the most pragmatic tools to advance ecosystem-based management in coastal and marine areas (CBD and STAP, 2012).

Spatial planning on land, and particularly in urban settings, has been more focused on economic and social development than on environmental protection, and has been slow to connect with integrated management frameworks on land and in river basins, partly due to administrative challenges posed by overlaps between administrative and natural system boundaries (Granit *et al.*, 2014). Different zones of the same water body on land and in coastal zones can be subject to a multitude of rules, governing entities and enforcement authorities related to differences between the borders of natural systems (e.g. river basins and coastal areas) and administrative units (e.g. national and municipal borders and exclusive economic zones) (see Figure 1).

A common objective of all the management approaches reviewed here is coordination across sectors. In each case one sector acts as the focal point, typically within a defined spatial unit through which it is not necessarily able to address impacts related to larger system linkages. This creates challenges when multiple political jurisdictions are involved. The rules by which limited freshwater supplies are allocated among competing users are often particularly complex and well entrenched. The biggest challenge lies in fitting such practices into a nested governance system in which the multiple levels of governance interact to establish management frameworks that are able to address the well-being of the system as a whole.

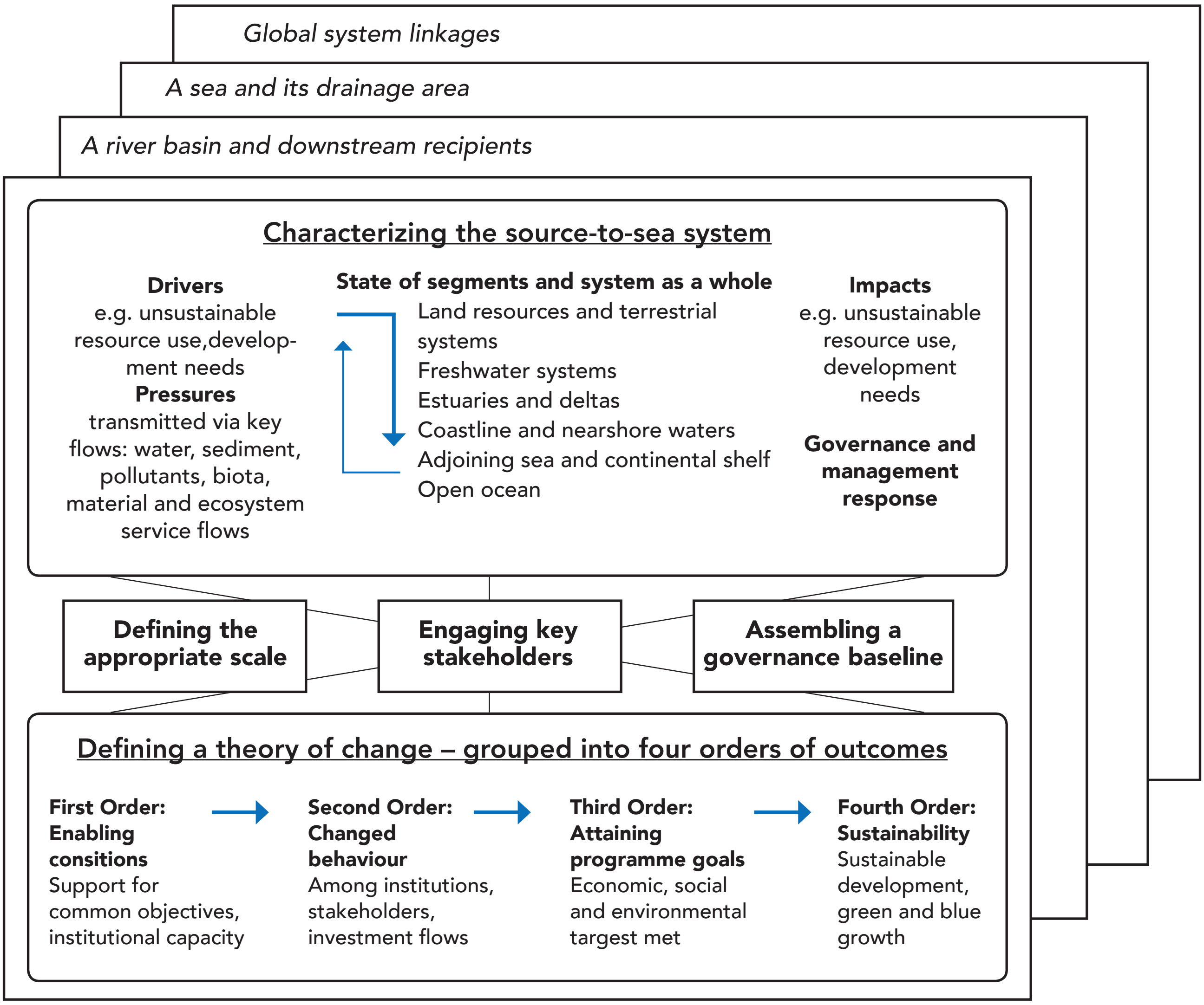
3

A CONCEPTUAL FRAMEWORK

TO SUPPORT SUSTAINABLE OUTCOMES IN SOURCE-TO-SEA SYSTEMS

Positive outcomes in source-to-sea systems require an approach to analysis, planning, policy-making and decision-making that considers the entire social, ecological and economic system, from the source of a river to the coastal area and even open ocean it flows into. This chapter introduces a conceptual framework to guide the design of future initiatives aimed at supporting green and blue growth in source-to-sea systems. The framework combines a set of elements that can together help identify appropriate courses of action in a given source-to-sea system: identifying key flows and priority issues; characterizing the system, defining an appropriate scale for analysis; analysing the existing governance and management systems through a governance baseline; engaging key stakeholders; and defining a theory of change to guide action. The way these elements link up is visualized in see Figure 2.

Figure 2. A source-to-sea conceptual framework

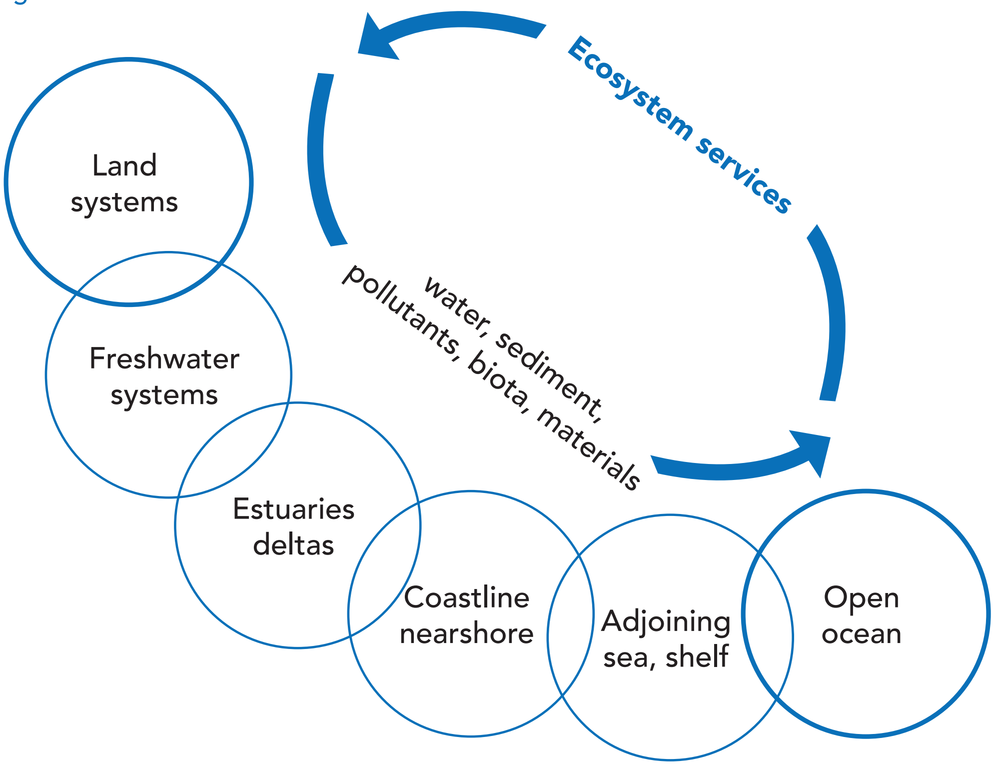


3.1 KEY FLOWS IN SOURCE-TO-SEA SYSTEMS

This section introduces the first element of a conceptual framework for connecting issues within source-to-sea systems, from land to coast and to open oceans by identifying the key flows that carry both impacts and benefits in the systems. These flows – of water, sediment, pollutants, materials, biota and ecosystem services – connect sub-systems at different spatial scales. They demonstrate how the geographical segments in the source-to-sea continuum are connected (see Figure 3).

The state of each segment can be affected by activities taking place in the others. It is important to take into account human influence on each of these flows and the resulting impacts at local to global scales, and these are also summarized below. When applied in the characterization of a given source-to-sea system (see below), this element of the conceptual framework should help in analysing ways of addressing negative aspects of these flows and enhancing positive aspects.

Figure 3. Key flows connecting geographies from source to sea: ecosystem services, water, sediment, pollutants, biological and material flows.



Ecosystem service flows

Ecosystem services – "the ecosystem conditions or processes utilized, actively or passively, to produce human well-being" (MA, 2005) – represent part of the total economic value of the planet (Costanza *et al.*, 1997). In a source-to-sea system, ecosystem services can include both beneficial flows and the absorption or reduction of detrimental flows before they can affect human populations.

Some ecosystem services are both delivered and used in the same area, but many are delivered from "provisioning" to "benefitting" areas by biophysical or anthropogenic processes, such as the flood-mitigation service provided by a dam upstream of an area at risk of flooding. "Ecosystem service flows" have been defined as "the spatial and temporal connections between provisioning and benefitting areas" (Serna-Chavez *et al.*, 2014). Different frameworks have been developed to support the assessment and quantification of ecosystem service flows (Burkhard *et al.*, 2014; Serna-Chavez *et al.*, 2014; Silvestri and Kershaw, 2010), but studies are still sparse.

In source-to-sea systems, the key flows described in this chapter are important transport agents for ecosystem services. For example, the Millennium Ecosystem Assessment identifies four categories of ecosystem service related to water in a source-to-sea framework: (i) provisioning services such as ensuring water supply for domestic use, industry, energy and food production; (ii) water-regulating services, which vary depending on ecosystems and can include water regulation and storage for flood and drought control, water purification, disease regulation and navigation; (iii) cultural services such as spiritual and religious values; and (iv) support services, for example providing a habitat for ecosystems, nutrient dispersal and recycling (MA, 2005). Human activities such as tourism to unique natural features (Costanza, 2008) and transportation of market goods from producing areas to users are also examples of ecosystem service flows.

Water flows

Flowing water transports sediment, nutrients and pollutants through the source-to-sea continuum. Changes in river flows affect the yield of reservoirs, the recharging of groundwater, and sediment transport and deposition patterns (Syvitski *et al.*, 2005). Likewise, water quality and flow regimes are interlinked. For example, water flows influence how pollutants are transported and retained, and the volume of water in the stream affects physical properties, such as temperature, and the concentration of pollutants (Nilsson and Malm Renöfeldt, 2008). Furthermore,

BOX 3.

Some examples of economic consequences of water flow alterations

The annual cost of damage caused by the increasing salinity in the Colorado River Basin – a combined effect of the drastic water diversions that began in the 1960s and return flow from irrigation – has been estimated at more than US$300 million, the bulk of it in the agricultural sector (Borda, 2004). More than US$30 million is now spent annually on measures to prevent over 1 Mt of dissolved salts (mostly resulting from human activity) from entering the Colorado River (Bureau of Reclamation, 2013), including irrigation management practices, erosion control, reduction in point source inputs from natural geologic sources, and dam operation procedures. In addition, the collapse of the Totoaba fishery in the upper Gulf of California was probably in part the result of the loss of brackish water spawning grounds in the Colorado River delta (Flanagan and Hendrickson, 1976).

The potential economic losses to fisheries from the planned 11 mainstream and 70 tributary dams along the course of the Mekong were estimated at US$1,000 million in 2015, rising to about US$2,000 million per year by 2030, due to further dam development (FAO, 2014). In the inner Niger Delta, the annual loss to fisheries as a consequence of two existing and one planned dam has been estimated at US$20 million (FAO, 2014).

excessive groundwater abstraction causes the intrusion of salt water into coastal aquifers (Ferguson and Gleeson, 2012), which may be further exacerbated by sea-level rise. Box 3 describes some cases where the economic costs of water flow alterations have been calculated.

Flow patterns, including seasonal variations between high and low flows, are essential to the ecological health of river, floodplain and estuarine ecosystems (Bunn and Arthington, 2002). The mixing of freshwater with salt water that occurs in deltas and estuaries creates brackish habitats where salinity fluctuates depending on tides, freshwater flows, rainfall and evaporation rates. Reduction of freshwater flows into these systems can lower their productivity and biodiversity, and result in over-salinization, as in the case of the Colorado River delta (Carriquiry and Sánchez, 1999). On the other hand, changes in climate, land use and ecology may reduce the amount of rainfall that is retained in soils, leading to erosion and to more frequent or higher peaks in run-off, and contribute to flood risk or flood severity along rivers and deltas.

Sediment flows

Sediments are supplied through erosion and transported and deposited by water flowing in river systems. These processes occur throughout the river network, but headwaters tend to supply most of the sediment while the lower reaches store and export it. In fact, almost 60 percent of sediment delivered to coastal zones globally derives from basins draining high in the mountains (Syvitski *et al.*, 2005). The major factors in sediment yield (that is, the mass of sediment leaving the basin) are climate, relief and rock type, the extent and type of vegetation cover, and the size of the basin (the larger the basin, the more potential storage).

Activities causing soil degradation and erosion in the catchment area of a source-to-sea system can increase the sediment load downstream, with potential impacts including smothering coral reefs and seagrass beds (Orth *et al.*, 2006; Wilkinson, 2008). Globally, however, reservoir construction is probably the most important factor influencing land–ocean sediment flows (Walling, 2006). Vörösmarty and Sahagian (2000) claim that regulated river basins trap approximately 30 percent of global sediment flows. The virtual elimination of sediment delivery contributes many times more to the submergence of numerous deltas than does global sea level rise (Syvitski *et al.*, 2009). Deltas where sediment delivery has been reduced by as much as 80–100 percent include the deltas of the Colorado, the Nile, the Krishna, the Yellow, the Chao Phraya and the Indus rivers (Syvitski *et al.*, 2009). Reduced sediment flows in rivers contributes therefore to coastal erosion, a significant challenge for many regions (Cai *et al.*, 2009; Liquete *et al.*, 2004; Ly, 1980; McManus, 2002).

Pollutant flows

A wide range of pollutants – substances that harm the environment or human health – can enter source-to-sea systems from a variety of sources. Their properties affect how they are transported through source-to-sea systems and their potential impacts on organisms and ecosystems along the way. Major groups of pollutants that are important for source-to-sea systems include environmentally persistent contaminants, solid waste/marine litter, and even nutrients and organic matter (see below).

In broad terms, pollutants enter water bodies from either point sources (concentrated flows like piped effluent from industries or wastewater treatment plants) or non-point sources like agricultural and urban run-off, polluted sediment, and atmospheric deposition. Once they enter a source-to-sea system, they may be deposited in sediment or carried long distances in dissolved or suspended form, contributing to problems further downstream that can be local, regional or even global.

When pollutants enter the sea, their concentration is generally reduced. The extent of dilution depends on the characteristics of the receiving body (currents, stratification and water exchange). Concentrations tend to be higher in inshore waters or in semi-enclosed seas than in the open sea, or in convergence zones where seawater currents meet and slow down in the ocean, as in the case of marine litter (Martinez *et al.*, 2009; Pichel *et al.*, 2007). Some pollutants accumulate in the food chain and can thus be transported long distances by fish or birds.

While there have been successes in controlling pollution, trends are mostly negative. The management of point sources, which is primarily a matter of treatment, regulation and enforcement, has progressed over the past century, but still poses major challenges in many developing countries and fast-growing urban areas. Today, more than 70 percent of industrial waste is still dumped untreated into waters in many developing countries (Corcoran and GRID-Arendal, 2010) and only an estimated 40 percent of the global population's sewage undergoes some form of treatment before being discharged into the environment (Baum *et al.*, 2013) and thus entering source-to-sea flows. In addition, current wastewater treatment systems may not be equipped to handle new pollutants that are being detected in the environment. Managing non-point sources requires a combination of measures that takes into consideration both the various sources of a pollutant in a watershed and the transport and retention processes. It is still a major challenge in most countries.

Nutrients and organic matter

The supply of nutrients and organic matter is an important limiting factor in the productivity of land, freshwater and marine ecosystems. They can, however, be considered pollutants in water ecosystems when they reach higher concentrations, causing problems such as eutrophication, leading to algal blooms and oxygen depletion.

During the 20th century, the global balance between inputs and outputs of nitrogen and phosphorous went from fairly balanced to a global surplus of 138 Mt and 11 Mt respectively (Bouwman *et al.*, 2013). Major contributors were the 700-percent increase in global fertilizer use in the second half of the century (Matson *et al.*, 1997; Tilman, 2001), and limited sewage treatment. As a result, we are now witnessing alarming rates of eutrophication in fresh and coastal water systems (Rabalais *et al.*, 2009; Seitzinger *et al.*, 2002; Smith, 2003); exponential increases in dead (hypoxic or anoxic) zones since the 1960s (Diaz and Rosenberg, 2008); increasingly frequent reports of harmful algae blooms since the 1970s (Dolah, 2000); and globally increased concentrations of the greenhouse gas N2O. The increasing concentrations of nutrients also contribute to the acidification of soil, freshwater resources and oceans (Doney, 2010; Tilman, 2001; Vitousek *et al.*, 1997) via acid rain (Vitousek *et al., 1997)* and CO2 emissions from decaying materials (Sunda and Cai, 2012).

Projections suggest there will be increases in nutrient inputs to coastal areas in most regions by 2050, along with more eutrophic coastal systems (Rabalais *et al.*, 2009; Seitzinger *et al.*, 2002), and exacerbated effects of eutrophication due to climate change (Rabalais *et al.*, 2009). Eutrophication occurs globally, although nutrient export from river basins is not evenly distributed. For example, the discharge of inorganic nitrogen is estimated to be highest from Europe and Asia (Glibert *et al.*, 2005). Atmospheric deposition can be a major contributor of nitrogen loads in some areas, accounting for as much as 25–30 percent of the total nitrogen in the Baltic Sea (HELCOM, 2005; Spokes and Jickells, 2005).

Systems also respond differently to nutrient loading. The Baltic Sea hosts the largest dead zone in

the world (Dybas, 2005) and has experienced a 10-fold increase in hypoxia over the past 115 years (Carstensen *et al., 2014)*. It also has practically all the characteristics that lead to vulnerability to eutrophication being a semi-enclosed body of water that has limited water exchange with the North Sea due to the narrow passages through Sweden and Denmark with strong vertical stratification.

Historically, phosphorus has been considered the priority nutrient controlling freshwater productivity (Schindler, 1974) while nitrogen has been thought to play this role in coastal waters (Howarth and Marino, 2006). However, upstream measures to reduce phosphorus-linked eutrophication in nearby freshwater bodies that have not also reduced nitrogen flows have exacerbated coastal eutrophication (Conley *et al*., 2009). Nutrient loading dynamics have now changed considerably in most regions, causing imbalances in nitrogen and phosphorous loading and making it more difficult to control eutrophication by reducing only one nutrient (Conley *et al., 2009; Paerl, 2009)*. The need for nutrient-control strategies that address both nitrogen and phosphorous is now well recognized (EPA, 2015).

Environmentally persistent contaminants

Fossil fuel combustion and the increasing use of pesticides and hormones in agriculture and livestock production are some of the major sources of environmentally persistent contaminants entering source-to-sea systems. These substances include persistent organic pollutants (POPs), heavy metals and pharmaceuticals. Many of these substances have been linked to reproductive, developmental, behavioural, neurological, endocrine and immunological adverse health effects in both humans and wildlife (Ross and Birnbaum, 2003; Williams and Cook, 2007). The cumulative effects of these various substances, both individually and in combination, have been identified as a major future global environmental challenge in both fresh and marine waters (STAP, 2012).

Low concentrations of pharmaceuticals and their metabolites have been detected with increasing frequency in the environment since the 1990s (Nikolaou *et al.*, 2007; Williams and Cook, 2007). Their potential impacts on aquatic organisms and humans have been identified as an area needing further study (Arnold *et al.*, 2013).

Solid waste and marine litter

Rivers and oceans are being used, legally and illegally, for waste disposal. Marine litter, which is increasingly a global environmental problem (STAP, 2011), regularly flows into the oceans from rivers and coastal areas and is difficult to manage. Jambeck *et al.* (2015) estimate that up to 12.7 Mt of plastic waste enter the oceans every year. Apart from the obvious aesthetic problems, marine litter also impacts biodiversity when wildlife ingests or becomes entangled in litter and when floating debris carry invasive species. It may even have impacts on our food system: if ingested by marine organisms, plastic can transfer toxic substances into the food chain and has also been shown to accumulate and concentrate POPs from other sources (Thompson *et al.*, 2009).

An area of particular concern is the increasing abundance of microplastics (< 5 mm), probably the most abundant type of plastic debris in the sea, and easily ingested by marine organisms (GESAMP, 2015; Law and Thompson, 2014). With the high rate of growth of coastal urban areas combined with climate change risks, such as the increased frequency of severe weather related events (UN-HABITAT, 2009), an increase in marine litter can be expected. Events such as hurricanes, tsunamis and tropical storms transport large amounts of litter out to sea. It is estimated that the Tokoku tsunami of 2011 created as much marine litter as would normally be produced over thousands of years from Japan's coast (Lebreton and Borrero, 2013). According to the Japanese government, the tsunami released 5 Mt of debris into the ocean, 1.5 Mt of which was floating debris (NOAA, 2013).

Biota flows

Alterations to water, sediment and pollutant flows interact to reduce biodiversity and ecological integrity in source-to-sea systems, and contribute to their vulnerability to other environmental changes. Illustrating the fact that source-to-sea flows are not exclusively from upstream to downstream, a number of fish species depend on the "ecological highways" provided by rivers to migrate between habitats (Gough *et al.*, 2012) during different phases of their life cycles. Some make extensive journeys within a river system to reach critical habitats, and others (like many species of salmon, shad, giant catfish, dorado, sturgeon and eel) migrate between the open sea and the rivers for reproduction.

Dams and other impediments risk disrupting these biota flows of fish, unless structures or other modifications are used to allow fish to pass around or through them. However, the use of fish passage devices is controversial, largely due to inappropriate design and failures in operation and maintenance (FAO, 2014). This, in combination with flow obstructions and other river modifications, has caused the disappearance or fragmentation of habitats and substantial declines in the populations of many fish species around the world (Gough *et al.*, 2012).

Exotic invasive species may spread through a source-to-sea system. They are more likely to settle in damaged habitats and can significantly alter the structure and functioning of the ecosystems they have entered (Gallardo *et al., 2016; Katsanevakis et al., 2014*). They may hinder economic activities by negatively affecting commercial species and recreational activities (Rosaen *et al., 2012*).

Material flows

Construction and other development activities can bring major flows of solid material into the source-to-sea continuum, as well as flows of material out of the system through, for example dredging, clearing rocks, and deliberate modifications to channels or coastline. Such material flows are growing rapidly in source-to-sea systems around the world. The drivers include urbanization and industrial development, increases in river and marine transport (for example piers, ports, bridges, tunnels, channel alterations), construction of dams and offshore wind farms, laying underwater cables and pipelines, natural disaster defence (particularly against flooding, storms and sea-level rise), and exploitation of marine resources (both mineral and biological).

Coastal landscapes in particular are being transformed. Similarly to terrestrial areas, undeveloped space in marine areas is becoming increasingly scarce. New sectors and industries add spatial demands that need to be made compatible with established sectors (Kannen, 2014). Where land is limited and demand for it is high, land reclamation is becoming increasingly economically viable compared to developing expensive seafront land (Gatto, 2015). In China, due to population density and limited land availability, many regional marine development plans involve large-scale reclamation of land from coastal areas, not least as it is considered a cheaper and more efficient way of building (Ding *et al.*, 2014).

Material flows can have major impacts on other key source-to-sea flows. Dam construction radically alters water flows, especially when it is combined with irrigation or other abstraction, along with its impacts on biological flows and sediment flows. Similarly, construction of coastal breakwater and seawalls, among others, can affect currents. Other material flows can also change erosion and sedimentation patterns and the way pollutants are transported through the system (and in many cases, construction brings polluting activities to the source-to-sea system), or the mix of salt and freshwater in deltas and estuaries. Material flows may also alter the shape and physical nature of banks, coast and underwater environments, in ways that harm important species or benefit invasive species (Bulleri and Chapman, 2010). Thus, development projects along the source-to-sea continuum need to be seen as a key flow that can greatly impact ecosystem services and other key flows.

3.2 CHARACTERIZING THE SYSTEM

Characterizing a source-to-sea system should start with identifying the issues that need to be addressed segment by segment, as well as for the system as a whole. This includes analyzing on the one hand the drivers and pressures for alteration of the connecting flows in the source-to-sea system and related ecosystem impacts, and on the other hand the governance and management decisions taken to date. Further alterations to a system and development priorities need to put in the context of the flows through the system, the existing governance system, and the power dynamics among stakeholders with different interests.

A variety of methodologies and tools can be applied to guide the characterization of a source-to-sea system, but taking full account of often complex system linkages can require significant time and resources. As a result, such linkages risk being underestimated or neglected. The key source-to-sea flows can be used to guide the analysis of linkages between the different geographical segments by applying methodologies such as the driving forces, pressures, stress, impact and response (DPSIR) framework (EEA, 2003a, 2003b).

GEF International Waters projects in transboundary river basins, lake systems, aquifers or large marine ecosystems (LMEs) undertake a transboundary diagnostic analysis (TDA)[3] to identify, quantify and set priorities for environmental problems that are transboundary in nature (GEF, 2013). As part of the TDA, a causal chain analysis can identify the sequence of causes and effects leading to a problem and thus enable identification of root causes and measures to address them. The causal chain analysis is closely related to systems thinking and the DPSIR approach, but is relatively simple compared to some other systems approaches. In a TDA process, consideration of causes and effects of key source-to-sea flow alterations can strengthen the analysis of linkages between the targeted water system and adjacent geographical segments in the broader system and guide the development of a strategic action programme (SAP) able to address prioritized source-to-sea issues.

3.3 DEFINING THE APPROPRIATE SCALE

Once the issues and the characteristics of the key flows, the individual ecosystems and the system as a whole have been identified, the scale determines at what levels the governance and management arrangements would need to be strengthened in order to respond to source-to-sea linkages (Figure 4). The appropriate scale could vary from one or more closely connected segments to a river basin and downstream recipient, a sea and its drainage area all the way to global system linkages illustrated by climate change drivers that put pressure on source-to-sea systems. Scale can be identified from a geographical perspective, with the river basin or the recipient water body as the starting point for tracing different key flows, or using a single issue, such as marine litter, as the starting point.

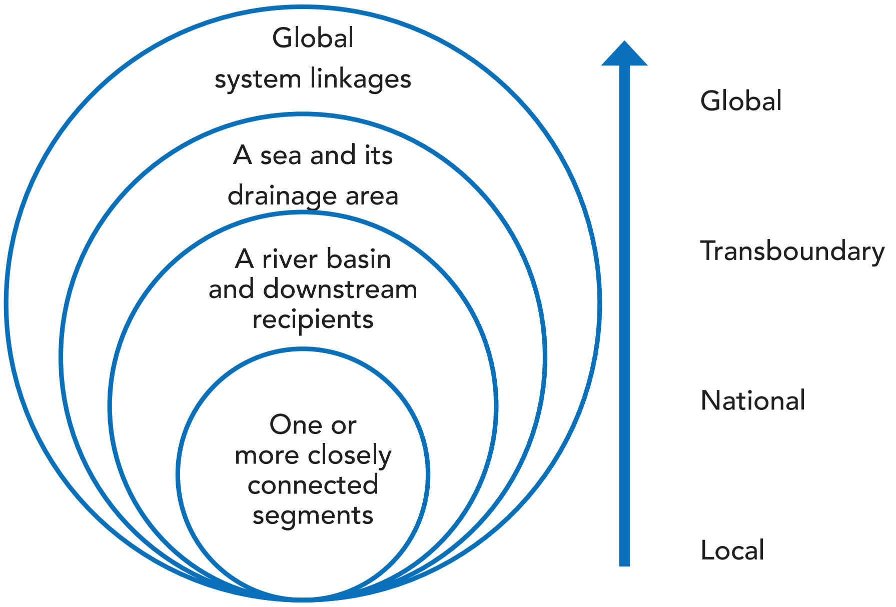
Although one scale should be identified as a starting point for analysis and action, adaptation will most likely be necessary at multiple scales. For example while protection of specific areas and management

3 TDA is applied in GEF International Waters projects to assess the biophysical status of a water body (Tengberg and Cabanban, 2013). It consists of the following steps: 1) identification and initial prioritization of transboundary problems; 2) gathering and interpreting information on environmental and human impacts of each problem; 3) causal-chain analysis to identify root causes of priority transboundary problems; and 4) completion of an analysis of institutions, laws, policies and projected investments.

of discrete causes and sources of environmental degradation may best be handled at a local level, cooperation is needed at the national and sometimes international levels to establish, coordinate and monitor the delivery of goals that link issues across larger geographical areas.

Defining the appropriate scale can be difficult, as alterations to key flows in a source-to-sea system can have impacts at local, national, transboundary and even global levels. If the geographical area taken into consideration during the planning stages of an intervention is too limited, the extent of impacts in remote areas may be overlooked. For example, impacts on deltas hundreds of kilometres downstream were unanticipated or underestimated during the planning of the extensive water diversions along the Colorado (Appendix 3F). Then again, the level of complexity generally increases with the scale, making strategic prioritization of issues even more important when operating in larger systems. The Bay of Bengal case study (Appendix 3B) illustrates the importance of scale when identifying source-to-sea flows into a large marine ecosystem and the need to clearly prioritize the key flows to address in a GEF strategic action programme.

Figure 4. Source-to-sea linkages and the need for governance and management responses at different scales



As many interventions in source-to-sea systems focus on one or a few closely connected segments, a key consideration for source-to-sea governance is to be able to place the goals and targets of such initiatives in the context of larger system linkages. The Partnerships in Environmental Management of the Seas of East Asia (PEMSEA) formulated an overarching framework for the sustainable development for the seas of East Asia and achieved pollution reduction in a number of targeted sites much thanks to efforts made at the local government level (Appendix 3A). In efforts aimed at reducing eutrophication in the Black Sea (the starting point), the Danube River was identified as the main contributor of nutrients, meaning that the appropriate scale for collaborative action also included the upstream countries of the Danube River Basin (Appendix 3C).

3.4 ASSEMBLING A GOVERNANCE BASELINE

The often complex governance arrangements in source-to-sea systems call for a deep understanding of their strengths and weaknesses when designing an appropriate course of action. Experiences from GEF International Waters initiatives show that the successful development of a TDA, adoption of an SAP[4] and strengthening of governance arrangements can sometimes be more dependent on political factors – the number of countries involved, political will to engage in regional collaboration, the existing governance arrangements and the capacity to implement the SAP in an adaptive way – than on the availability of funding (Söderbaum and Granit, 2014; Tengberg and Andreasson, 2012). While planning and decision-making by sector and by the segments of a source-to-sea system will continue to be necessary, it is increasingly important to establish governance mechanisms that can consider impacts, trade-offs and synergies in the system as a whole.

Governance baselines (Juda and Hennessey, 2001; Olsen *et al.*, 2009, 2011; UNEP-GPA, 2006) provide an analysis of the ecosystem governance processes and outcomes in a geographically defined area. Preparation of a governance baseline can reveal where the management of linkages among segments in a source-to-sea system is weak or absent, and identify the consequences of actions that did not take into account the functioning of the system as a whole. Governance baselines use standardized indicators (Anderson *et al.*, 2015; Cochrane *et al.*, 2009; Olsen *et al.*, 2009, 2011) to benchmark the maturity of the governance system and the degree to which the enabling conditions for an ecosystem governance initiative are in place at a given time.

Based on descriptions by Olsen *et al.* (2009, 2011), a governance baseline structures analysis of the evolution of the existing governance system to inform a forward-looking source-to-sea planning and governance process. In all but a few small-scale instances, source-to-sea systems have a history of management and examples of successes and failures in addressing issues raised by change in segments of the system.

A governance baseline study has two parts. The first focuses on the past and current performance of the governance system in responding to changes in the state of ecosystems in a specific locale. It should look for evidence of adaptation and learning and identify where management objectives and strategies may be in conflict. The second part draws on the strengths and weaknesses of the existing governance system to design a strategic approach for a new ecosystem governance programme or a new phase in an existing programme.

3.5 ENGAGING KEY STAKEHOLDERS

The design of a course of action requires a thorough understanding of both social and sectoral dynamics in a source-to-sea system. This calls for identifying who the affected stakeholders are and how they are organized with respect to the use and management of resources in the system. Stakeholders might be defined by economic sectors (like agriculture and industry), environmental interests, and cultural or indigenous groups that rely on ecosystem services provided by the system. What are their respective priorities with regard to resource management? How do the current management arrangements reflect those priorities? To what extent do the stakeholders participate in operational and policy decisions at local, national or regional levels?

The integrated management approaches that are applied in source-to-sea systems today all have strong focus on inclusiveness and participation, but experience shows that involvement of key resource users and other stakeholders is challenging (see Appendix 3). As noted in a 2007 case review looking at interlinked management of river basins and coastal areas (Pickaver and Sadacharan, 2007), there is often a bias in favour of socio-economically more profitable activities, which is especially problematic in the source-to-sea context as there is often an unfortunate lack of validation of and appreciation for the services provided by downstream systems. In addition, the lack of awareness among stakeholders, both upstream (the implications of activities in the watershed on coastal communities) and downstream (how their livelihoods may be threatened by ill-coordinated upstream activities) can limit the extent of buy-in and support for a course of action and represent important constraints when dealing with source-to-sea linkages.

4 The GEF has adopted the TDA/SAP approach as a strategic planning tool for projects in its International Waters focal area. The TDA/SAP approach centres on the identification, quantification and prioritization of environmental problems that are transboundary in nature (the TDA; see note above) and, based on this, the formulation of a negotiated policy document establishing clear priorities for action to resolve identified problems (the SAP) (GEF, 2013). In the implementation of an SAP, countries can adopt those management approaches that are most suitable to serve the objectives in the particular setting, supported by national inter-ministry committees and a regional mechanism in the selected river basin or large marine ecosystem.

3.6 DEFINING A THEORY OF CHANGE

Source-to-sea governance is a complex technical, cross-sectoral and diplomatic challenge extending over decades. As human activity intensifies, and as climate change alters the dynamics of ecosystem behaviour, governance that can address entire source-to-sea systems demands adaptation and learning. The combination of forces acting on source-to-sea systems calls for a theory of change that can guide governance and management responses. A theory of change describes the building blocks that it is hoped will lead to a particular desired long-term outcome (Davies, 2012).

Because so much is at stake, such a governance process is politically charged. It is therefore essential that it also be recognized as a socio-political process and not only as a set of scientific and engineering problems and challenges. Engineering and scientific analysis is essential to identify the environmental and economic implications of policies and decisions; however, it is rarely the primary driver of action, which is largely driven by economic interests and political priorities. Thus, a defining feature of the theory of change framework proposed here is the recognition that economic, political and diplomatic factors are equally important as science and the engineering in source-to-sea governance (Islam and Susskind, 2012; Lee, 1993; Söderbaum and Granit, 2014).

Our proposed theory of change framework applies the Orders of Outcomes framework (Olsen, 2003; Olsen *et al.*, 1999; UNEP-GPA, 2006), which sets out four "orders" of outcomes in a source-to-sea programme's responses to changing societal, economic and environmental conditions, leading to the ultimate long-term goal of sustainable forms of development. These four orders are described in Table 1.

Table 1. A theory of change framework for the governance of source-to-sea systems – measurable outcomes disaggregated into four "orders"

Order of outcomes	Description
First	Creation of the enabling conditions for a source-to-sea governance initiative. The most critical are specific long-term goals (see the Third Order), governmental commitment, supportive constituencies (resource users), and adequate capacity to implement the ecosystem approach among the responsible governmental and non-governmental institutions in the source-to-sea system.
Second	Changed behaviours of resource users, in such a way as to reduce stress on the source-to-sea system and increase collaboration among institutions.
Third	Achievement of the source-to-sea governance initiative's desired changes in societal and environmental conditions as defined by its First Order goals.
Fourth	A more sustainable and resilient source-to-sea system. Blue and green growth opportunities materialize.

The outcomes associated with each order do not accumulate in a strictly sequential manner. In complex source-to-sea systems, evidence of Second and Third Order outcomes may be seen at the smaller geographic scales addressed by pilot projects or within segments or sectors that are amenable to new approaches to issues of concern. The assembly of First Order outcomes at the full source-to-sea system scale often requires decades of effort and the skilful practice of adaptive management – a systematic approach for improving resources management by learning from management outcomes (Szaro *et al., 1999)* – as ecosystem processes evolve.

The First Order of outcomes concerns enabling conditions for the implementation of a programme. The experiences of large-scale ecosystem governance initiatives addressing both watersheds and their associated estuaries, coastlines and marine areas (Olsen and Nickerson, 2003) and of diverse coastal and marine management initiatives (National Research Council (U.S.), 2008; Olsen, 2003; Olsen *et al.*, 1999) suggest four essential enabling conditions:

1) Clear long-term goals addressing the social, economic and environmental dimensions of a source-to-sea initiative.

2) Commitment from responsible government agencies, indicating that the necessary authority, resources and political will be available.

3) Constituencies among the stakeholders that understand and actively support the goals and strategy of the source-to-sea initiative.

4) Sufficient capacity among key stakeholder groups and institutions to practise an ecosystem approach and carry the initiative forward to achieve its Third Order outcomes.

While this framework addresses the *outcomes* of an initiative, other frameworks detail the sequence of the actions that constitute the *process* by which First Order outcomes are achieved. The management cycle includes programme implementation, monitoring and evaluation but the guidance is invariably most detailed for the actions associated with the First Order that lead to approval of a set of policy reforms and/or a plan of action. Versions of this cyclical process as it applies to integrated coastal management were put forward by GESAMP (1996), Olsen *et al*. (1999, 1998) and PEMSEA (Chua, 1998), while others describe the steps in integrated water resources management (GWP, 2012) and marine spatial planning (Ehler and Douvere, 2009). The TDA/SAP process (GEF, 2013) applied by the GEF International Waters programme is another version with similar steps.

The Second Order outcomes come during implementation. They take the form of changes in how user groups interact with the environment, and associated changes in the conduct of institutions. These changes are essential to achieving the Third Order outcomes.

The strengths and weaknesses of a source-to-sea initiative's design often become apparent during identification and tracking of Second Order outcomes; for example, in the extent to which institutions collaborate and amend their practices and the programme (or programmes) demonstrate the capacity to make the practices advocated by a source-to-sea initiative operational. The balance between voluntary compliance and enforcement among resource users is critical to success or failure in generating the Third Order outcomes. Reforms to the management of many coastal fisheries, for example, require support among the fishers affected if non-compliance is not to become a major issue.

The Third Order outcomes are defined by goals for sectors or segments within a source-to-sea system. As expressions of ecosystem governance, source-to-sea initiatives should set specific (ideally time-bound and quantitative) societal, economic and environmental targets whose achievement contributes to the greater sustainability and resilience of the system as a whole. In actuality, sector-by-sector management programmes are typically designed, implemented and evaluated discretely.

Collaboration among programmes and institutions, and the compatibility of their objectives, is highly variable, especially where transboundary systems are concerned. Experience has shown that winning agreement on the definition of Third Order goals that encompass more than one sector is difficult – even impossible – where trust among the parties concerned is poor, and stakeholder interests are in conflict. The result is vaguely stated goals and ambiguity about the process by which desired outcomes will be achieved. If such ambiguities are not resolved during the life of an initiative it will be difficult to evaluate whether its actions increase or diminish the prospects for greater resilience and sustainability in a source-to-sea system. Where interests are in conflict and the different geographical segments in a source-to-sea system are being utilized for different purposes, the challenges of reaching common goals lie in the realm of economics, politics and diplomacy (Söderbaum and Granit, 2014).

The Fourth Order of outcomes addresses the overarching aim of any source-to-sea initiative: contribution to greater sustainability. Since the UNCED in 1992, it has been widely accepted that the ultimate goal of development and the governance of socio-environmental systems is sustainability and the achievement of conditions where development "meets the needs of the present without compromising the ability of future generations to meet their own needs" (UNWCED, 1987). This broad foundational statement has since been translated into more specific, concrete terms in documents such as the 2030 Agenda for Sustainable Development (UNGA, 2015) and in the Paris Agreement on Climate Change (UNFCCC, 2015).

4

APPLYING THE THEORY OF CHANGE FRAMEWORK

TO SOURCE-TO-SEA CASE STUDIES

Valuable experiences have been gained in addressing environmental degradation and improving governance and management within source-to-sea systems. There have been several long-term initiatives to remedy downstream impacts of large-scale water diversion, to reduce pollutant loads, and to improve the planning of multiple activities. To learn from these processes and to identify challenges and successes in addressing key source-to-sea flows in multiple geographical segments we carried out a case study assessment. It is based on a review of initiatives in East Asia; the Bay of Bengal; the Danube River and the Black Sea; the Baltic Sea; Caribbean (SIDS; and the Colorado River, its delta and the Gulf of California. Some of these multi-country initiatives have been supported by the GEF and are summarized in Table 2, while more detailed case descriptions can be found in Appendix 3.

Table 2. Case study overview

Asia and the Pacific	
Collaboration in the Seas of East Asia – Partnerships in Environmental Management of the Seas of East Asia (PEMSEA)	The East Asian Seas region contains a number of LMEs, subregional seas and their coastal areas. The GEF has invested for more than 20 years in assessing and improving the status of these LMEs. Work has included developing and implementing the Sustainable Development Strategy for the Seas of East Asia, which identifies ICM as a practical framework for sustainable development and provides an overarching framework for management of the region's LMEs.
Bay of Bengal Large Marine Ecosystem	The Bay of Bengal large marine ecosystem (BOBLME) is one of the largest LMEs globally. A GEF-supported project in the BOBLME has started to establish enabling conditions for ecosystem-based management, carrying out a TDA, and developing collaboration among the participating countries, which have formally committed to a strategic action plan. Transboundary concerns have been identified in the areas of overexploitation of marine living resources; degradation of critical habitats; and pollution/water quality.
Europe and Central Asia	
Danube River and Black Sea Collaboration	In the 1970s and 1980s, the ecosystems of the western Black Sea collapsed as a combined effect of pollution and unregulated fishing. In 1990, about 40,000 km2 of the north-western shelf of the Black Sea was hypoxic and effectively a dead zone. The link between Black Sea eutrophication and Danube river inflow was recognized in both the 1994 Bucharest Convention and the 1998 Danube River Protection Convention. GEF started investment in the Danube and Black Sea in the beginning of the 1990s. Major improvements have since been documented in the status of the Black Sea.
Baltic Sea Collaboration	Efforts to protect the semi-enclosed and brackish Baltic Sea through international collaboration between the surrounding countries date back to 1960s. Decades of pollution control have resulted in cleaner beaches and healthier seafood, but the Baltic Sea remains the most eutrophic marine area in the world. Enabling conditions for better governance of the Baltic Sea have emerged over a long period. Governance arrangements in the Baltic include several parallel frameworks, including some at the EU level and some including Russia, like the Helsinki Commission (HELCOM).
North and Latin America	
Caribbean Small Island Developing States and links to the Larger Caribbean Sea Basin – Integrated Watershed and Coastal Area Management (IWCAM)	Water resources, coastal areas and ecosystems in the 13 SIDS of the Caribbean and in the larger Caribbean basin are exposed to a number of stressors The GEF has supported a series of projects on integrated water and natural resources management in the Caribbean, including the Integrated Watershed and Coastal Areas Management in Caribbean SIDS project, which ran from 2006 to 2011.
Colorado Basin and Delta, and Upper Gulf of California	The majority of agreements to allocate the water of the Colorado River and its tributaries that have been signed since 1922 have only designated water rights in terms of human use, with no water legally reserved for ecosystems and no water quality standards. As a result, the salinity in the Colorado River basin has increased dramatically and the amount of water flowing into the sea has been drastically reduced. Efforts to address some of the key environmental pressures include salinity control in the Colorado basin, ensuring environmental flows to the delta, regulating fisheries and strengthening marine area protection in the Gulf of California.

The case studies provide interesting insights on addressing whole or partial source-to-sea systems. Examining the cases in the light of the theory of change developed in Section 3.6 reveals some of these insights, along with issues that need to be considered as source-to-sea initiatives mature.

4.1 ESTABLISHING ENABLING CONDITIONS: FIRST ORDER OUTCOMES

The case studies demonstrate that establishing a critical mass of First Order enabling conditions for better governance remains a central challenge in many source-to-sea systems, even after decades of collaboration. Problems are associated with limited coordination or disagreement between the institutions responsible for different segments of a source-to-sea system; and involving resource-using sectors and other key stakeholders. Progress towards desired Second and Third Order outcomes demands long-term commitment and acceptance that advances will be incremental. This calls for identifying strategic priorities to strengthen the weaker links in enabling conditions, building on existing strengths and showcasing the benefits of collaborative action.

PEMSEA in East Asia is an example of a programme that has strengthened enabling conditions incrementally through its multiple phases of programme implementation. This has included gradually expanding the scope of the programme towards a more inclusive source-to-sea agenda. Over its more than 20 years of implementation, PEMSEA has created regional governance arrangements comprising PEMSEA member countries, non-country partners and a network of local governments. PEMSEA has successfully promoted interagency and inter-sectoral coordination (in 75 percent of the participating countries) and has contributed to impressive rates of development and implementation of national policies, strategies, action plans and programmes in coastal and ocean management and river basin management (in 84 percent of the countries). However, no river basin organization has yet joined. The 2012 GEF Impact Evaluation of the South China Sea and Adjacent Areas concluded that many of the PEMSEA sites face the classic upstream/downstream dilemma when it comes to scaling up ICM: inland local governments need to invest in activities that will largely benefit local governments in coastal areas.

The first-phase **Caribbean IWCAM** project created the foundations for an IWCAM approach in the participating SIDS, as well as strengthening the commitment to IWCAM of participating regional institutions and enhancing their capacity to sustain IWCAM efforts. However, Caribbean SIDS still face major institutional and governance barriers to creating First Order enabling conditions in this large region. Planning processes are sectorally driven and do not take into consideration principles of ecosystem services flows. There are gaps in institutional mandates and in legislative and regulatory instruments that do not adequately address coordinated planning for IWRM, SLM and biodiversity management. A successor project, Integrating Water, Land and Ecosystem Management in Caribbean Small Island Developing States (GEF IWEco), takes an integrated approach to water, land and ecosystem services management and is designed to be supported by policy, institutional and legislative reform in anticipation of reaching Third Order outcomes.

The **BOBLME** project has in its first phase developed reasonable formal and informal collaboration among the eight littoral countries. Formal commitments have been made to address the priorities of the adopted strategic action plan, including some critical source-to-sea flows. However, upstream linkages beyond the coastal zone in relevant river basins have not been identified, including how to link different but related management approaches, such as habitat management and ICM. In addition, the BOBLME project has struggled to involve key sectors concerned. Thus major gaps in the enabling conditions remain.

The Danube River and Black Sea collaboration formalized joint goals for the International Commission for the Protection of the Danube River (ICPDR) and the Black Sea Commission (BSC) to reduce the eutrophication of the Black Sea. EU legislation has greatly assisted in garnering political commitment towards nutrient reduction among the majority of the Danube River countries. Among the Black Sea countries, achieving the necessary collaboration among governmental institutions has proved more challenging. For example, the terminal evaluation of the Black Sea Ecosystem Recovery Project found that no revisions to agricultural policy were instituted to reduce non-point run-off even though this was identified as critical to environmental restoration goals.

The several transnational governance frameworks for the **Baltic** lead to overlap and potential inefficiency. Among the EU members, implementing EU water-related directives, such as the Water Framework Directive and the Marine Strategy Framework Directive, is important to realize their common goal of achieving good environmental status by 2020. It has catalysed some countries (like Sweden) to rethink and redesign the institutional structures by which they govern water-related issues.

4.2 BEHAVIOURAL CHANGE: SECOND ORDER OUTCOMES

Demonstration projects, usually at a small geographic scale or targeting a single activity (such as addressing a specific source of pollution, illegal logging or chronic over-fishing) may produce Second and Third Order outcomes within a few years. However, changing how resources such as water are utilized at the source-to-sea system scale requires several phases of sustained, and adaptive, governance. Particularly difficult is instigating behavioural change in sectors that fall outside the direct sphere of influence of an initiative and stakeholders/resource users located upstream from the targeted area.

The terminal evaluation of the Caribbean **IWCAM** found that the project had triggered spontaneous replication and in some cases had catalytic impacts, notably in the adoption of new watershed/coastal zone management schemes, for example in St Lucia, the Dominican Republic and the Bahamas. The IWEco successor project is designed to support further scaling up of successful approaches. In parallel, an SAP implementation project is being implemented in the Caribbean LME, but only modest stress-reduction actions are anticipated under this project, all focused on fisheries. We found no clear source-to-sea linkages between the SAP implementation project and the IWCAM and IWEco projects. The Caribbean LME SAP implementation project does not address critical source-to-sea flows related to pollution and upstream pressures on coastal habitats, which have been identified as priorities by the IWCAM and IWeco projects.

In the **Danube River and Black Sea collaboration** a key challenge raised by the terminal evaluations of both the Danube Regional and the Black Sea

Ecosystem Recovery projects is the struggle to involve ministries beyond water and environment, and affect their policies. The Danube Regional Project did include activities to promote Second Order changes through best agricultural practices and the use of P-free detergents, but according to the terminal evaluation difficulties in engaging related ministries limited success. In the case of the Black Sea Ecosystem Recovery Project, there was limited focus on agriculture despite it having been identified as a significant land-based source of nitrogen loading. However, the collaboration in the Danube River/ Black Sea region and PEMSEA have both contributed to changes in investment flows by contributing to the setting up of investment funds, an important factor in efforts to achieve Third Order outcomes.

In the **Baltic** and in the **Colorado** basin, the riparian countries have invested substantially in behavior change interventions to achieve common commitments in relation to, for example, controlling salinity in the Colorado basin and reducing nutrient loads from the Baltic Sea countries. In the **Baltic**, all riparian countries have agreed on national nutrient reduction targets, but the vastly different starting points of local actors and stakeholders when it comes to addressing seawater quality and eutrophication mean that implementation is too slow. As an example, two-thirds of the municipalities in the Baltic Sea countries are either unaware of the problems or have insufficient resources to effectively address them (Dahlgren *et al., 2015)*. The capacity to manage protected areas in the **Gulf of California** has improved over the last decades, but in the case of the Upper Gulf of California and Colorado River Delta Biosphere Reserve, efforts to conserve biodiversity and ecosystems suffer from poor intergovernmental coordination, conflicts among sectors and waning support from fishing communities.

4.3 IMPROVING ENVIRONMENTAL AND SOCIAL CONDITIONS: THIRD ORDER OUTCOMES

The case studies show that failure to effectively address source-to-sea key flows due to gaps in First Order enabling conditions or failure to instigate required Second Order behavioural change will prevent or limit the attainment of stated Third Order societal and environmental targets.

The 2012 GEF Impact Evaluation of the South China Sea and Adjacent Areas, which covered not only PEMSEA but several other GEF initiatives, concluded that GEF-supported approaches had generally been effective at the specific sites where they have been implemented, but that the results of stress reduction have often been limited because of larger-scale factors that the demonstrations could not address, such as land-based pollution from tourism and agriculture.

Major improvements have been documented in the condition of the **Black Sea**, thanks to reductions in severe eutrophication (ICPDR, 2007). Third Order outcomes have included: the virtual elimination of the once expansive hypoxic zone covering the Northwest Shelf of the Black Sea; oxygen levels at near saturation in most areas; and doubled diversity of benthic indicator species since the 1980s. These remarkable accomplishments were assisted by a dramatic drop in agricultural production after the economic downturn in many lower Danube countries, but shows that early recognition of source-to-sea linkages and concerted effort to achieve policy and regulatory reform among upstream countries and stakeholders can, in combination with targeted investments, contribute to reversing negative environmental trends.

Nutrient discharge into the **Baltic Sea** has also been reduced in recent decades, but progress has been slow. To accelerate the pace and achieve Third Order outcomes, identified needs include a broader understanding of the eutrophication challenges among political leaders at national and municipal levels and increased knowledge to enable the identification of cost-effective combination of measures at the local level.

Despite efforts by the USA and Mexico to resolve some of the major source-to-sea-related pressures on the **Colorado** basin and its downstream segments, problems persist and Third Order outcomes remain elusive. The costs to the USA of salt removal in the basin are likely to increase by 50 percent by 2030 (Borda, 2004). The results from the environmental flows secured for the Colorado River Delta are yet to be evaluated, but they only represent a tiny fraction of the flows that were once delivered to the delta. In the Gulf of California, conservation efforts have focused on individual sites or on narrowly defined strategies, paying insufficient attention to land-sea connections – important obstacles to the achievement of Third Order outcomes.

4.4 TOWARDS GREATER SUSTAINABILITY: FOURTH ORDER OUTCOMES

Sustainability often remains an abstract concept. All of the initiatives reviewed aim ultimately to contribute to sustainability, the Fourth Order outcome, but even in those cases where Third Order outcomes have been achieved, it is difficult to make the case that this has led to full triple-bottom-line sustainability. In some cases, considerable advances have been made, such as in the Black Sea, but large systems continue to change as do human uses and pressures acting on them.

As the 2030 Agenda underlines, the road towards sustainability requires setting goals and implementing strategies on a diversity of issues, most of which coming into play at source-to-sea system scale. The source-to-sea conceptual framework connects to several overarching Sustainable Development Goals such as Goal 6 on sustainable management of water and sanitation for all; Goal 14 on sustainable use of the oceans, seas and marine resources; and Goal 15 on sustainable use of terrestrial ecosystems, which are in turn closely linked to others, such as Goal 1 on ending poverty; Goal 13 on combating climate change; Goal 9 on building resilient infrastructure; Goal 7 on sustainable and modern energy for all; and Goal 11 on making cities and human settlements resilient and sustainable. The 2030 Agenda is therefore a useful description of the diverse set of issues that needs to be met to achieve sustainable development and the source-to-sea conceptual framework can be helpful in identifying courses of action to achieve some of the goals and targets.

5 CONCLUSIONS

Source-to-sea systems are at risk. There is evidence of substantial ecosystem degradation in the source-to-sea continuum. This degradation could have significant impacts on the livelihoods of growing populations who depend on the services these ecosystems provide. Pressures from rapid human development activities upstream in river basins, midstream in coastal zones and on into marine areas can, if not addressed, jeopardize sustainability in these systems. Given projections of increasing resource demands, and the migration of human activity seaward, trade-offs between the needs of different sectors and segments within source-to-sea systems are certain to become more apparent and dramatic in the decades to come.

Source-to-sea systems are interconnected by key flows. For achieving sustainability, it is vital to treat source-to-sea systems as interconnected, linked by flows from land, via rivers, lakes and groundwater reservoirs towards deltas and estuaries, coasts and the open seas. A number of key flows in the form of water, sediment, pollutants, materials, biota and ecosystem services connect sub-systems at different spatial scales. These scales can vary from one or more closely connected segments, to a river basin and downstream recipient, a sea and its drainage area, all the way to global system issues such as climate change drivers. Existing governance and management arrangements face significant challenges in addressing such system connections, particularly in the marine space.

Gaps in biophysical knowledge need to be filled. While our knowledge of how human intervention influences individual segments of source-to-sea systems is relatively good, there remain great knowledge gaps around impacts that span across segments of source-to-sea systems, and of the vulnerability of ecosystems within the system segments to different types of flow alteration. Building this knowledge, and investing in remedial action, requires understanding the interdependencies between ecosystem services across the system, and the implications of trade-offs. Biophysical scientific frameworks that span knowledge domains should be encouraged.

Coordinated governance arrangements that can address system linkages are needed to implement a source-to-sea approach. There are a variety of management approaches to apply and adapt to serve the objectives of a particular setting. Most of these aim to promote coordination across sectors to achieve management objectives related to land (SLM), forests (SFM), water resources (IWRM), coastal areas (ICM), marine areas (MSP) etc. There is typically one sector acting as focal point through which others should be coordinated. This creates challenges in a source-to-sea system where multiple political jurisdictions are involved and management frameworks are often fragmented. One of the biggest challenges is fitting sector-based management practices into a nested governance system: one in which the multiple levels of governance interact to establish management frameworks capable of addressing the well-being of the system as a whole. Institutions with the authority and capacity to address all segments within a given source-to-sea systems are rare. As policy, planning and decision-making by sector and in the different segments of a source-to-sea system will continue to be necessary, decentralized, nested governance systems are still required. Thus, source-to-sea systems need governance arrangements that can balance development objectives across segments, taking key flows into account and are capable of coordinating the different management objectives.

While changes in source-to-sea systems are slow and interlinkages complex, learning and adapting to change need to happen at a faster pace. The review of case studies in this paper shows that it has taken decades to understand and begin to address source-to-sea system degradation. This is largely a consequence of the complexity and scope of source-to-sea systems. It takes long periods of sustained effort and investment to achieve changes and then to mainstream practices that operationalize a source-to-sea approach through changed behavior. Stress-reduction measures need to be implemented in large areas and it takes a long time to detect change in the ecosystems. Global environmental benefits are seldom seen in source-to-sea systems in the near term. Thus there is a need to learn faster about change by improving monitoring in source-to-sea systems. This can inform the design of better interventions and increase the efficiency and effectiveness of programmes to build sustainability in these systems.

The source-to-sea conceptual framework introduces an approach to guide the design of future initiatives aimed at improving sustainability in source-to-sea systems. It supports analysis, planning, policy-making and decision-making that considers the entire social, ecological and economic system from source to sea, evaluates the cumulative impacts of human activities, and provides conditions for blue and/or green growth. The conceptual framework presented in this paper should help stakeholders at different spatial scales in the continuum to identify and design a context-specific medium- to long-term strategy to disrupt detrimental flows and enhance positive ecosystem service flows. It is an aid to developing operational methods and tools to put source-to-sea governance into practice. It also offers a way to recognize system linkages in work to achieve development aspirations defined in the 2030 Agenda and to tackle the major impacts of climate change on the source-to-sea continuum. Central to the conceptual framework is the definition of a robust theory of change developed by stakeholders coming together to address key flows in parts of the continuum or across larger spatial scales.

The design of a course of action to build sustainability should be based on a comprehensive understanding of the existing governance and management set-up in the system as a whole. This is not only to identify issues that can be addressed, but also to ensure that any planned course of action is calibrated to the particular strengths and weaknesses of the existing governance system and the capacities of the institutions and stakeholders involved. As suggested in this paper, an analysis of key flows could enhance the understanding of system linkages, and a governance baseline will support identification of appropriate management approaches.

A theory of change is needed that can guide governance and management responses in a source-to-sea system. The adoption of a unifying theory of change could facilitate integration across segments, setting common goals, and recognizing and documenting achievements. It can describe the steps that it is hoped will lead to a particular long-term outcome. Our conceptual framework includes an outline theory of change that frames governance and management options around four orders of outcomes. The first order of outcome focus on the creation of the enabling conditions for a source-to-sea governance initiative. This include defining and agreeing on specific long-term goals, governmental commitment, supportive constituencies and adequate capacity to implement the ecosystem approach among the responsible governmental and non-governmental institutions in the source-to-sea system. The second order of outcome refers to the changed behaviours of resource users so that stress in the source-to-sea system is reduced. The third order concern the achievement of the source-to-sea governance initiative's desired changes in societal and environmental conditions as defined in the first order goal setting agenda. The fourth order outcome would be defined by achieving a truly more sustainable and resilient source-to-sea system in which blue and/or green growth opportunities materialize in line with the 2030 Agenda for Sustainable Development.

Learn from experience. There is a growing body of experience in coordinated action to improve source-to-sea sustainability. This study has attempted to draw some lessons by reviewing experiences in the light of our source-to-sea conceptual framework. However, there is much more that could be done to benefit from collaborative learning across source-to-sea initiatives. In this regard, the common conceptual framework, and particularly the outline theory of change, could help to monitor, compare and learn from future efforts.

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APPENDICES

APPENDIX 1.
LIST OF PROJECTS SELECTED FOR A RAPID ASSESSMENT OF THE SOURCE-TO-SEA-RELEVANT GEF PORTFOLIO[5]

International Waters focal area

Scale[a]	GEF project ID number[b]
Global (18)	14, 884, 1223, 1531, 1893, 2261, 3639, 3726, 3900, 4001, 4212, 4452, 4489, 4533, 5271, 5278, 5400, 5729
Large marine ecosystem (48)	1909, 3558, 1188, 789, 3305, 5753, 1247, 4940, 1462, 5513, 5905, 3559, 4487, 2093, 3809, 1252, 1270, 885, 5401, 5538, 790, 4343, 2454, 2700, 3025, 4936, 5405, 5768, 3522, 3524, 3619, 4690, 2131, 4746, 5393, 922, 1618, 3620, 1580, 2263, 5269, 3229, 3977, 3990, 963, 1032, 5304, 5542
River basin (34)	842, 5526, 1109, 1093, 1111, 6964, 2701, 9054, 2706, 1094, 2584, 2138, 2586, 5404, 1375, 6962, 5301, 1014, 1460, 2042, 1661, 2044, 2544, 4483, 5556, 3978, 1591, 1254, 1248, 3766, 5765, 791, 886, 3519,
River basin and aquifer (2)	5284, 5535
Aquifer (4)	970, 4966, 3690, 974
Lake basin (6)	767, 4748, 1017, 5674, 2133, 5748
Other	2098, 2129

a The spatial that is the starting point for analysis and action. All scales except global are within a specific source-to-sea system.

b For details of these projects see the GEF project database at https://www.thegef.org/gef/gef_projects_funding.

Persistent Organic Pollutants focal area

Scale	GEF project ID number
Global (4)	1016, 1802, 3648, 5307
Regional (27)	1331, 1348, 2526, 2720, 2770, 3614, 3732, 3942, 3968, 3969, 3994, 4066, 4074, 4611, 4668, 4740, 4881, 4886, 4894, 5000, 5082, 5148, 5322, 5407, 5532, 5554, 5558

Chemicals and Waste focal area

Scale	GEF project ID number
Global (1)	6959
Regional (6)	6944, 6978, 9080, 9098, 9101, 9185
National (29)	6921, 6928, 6939, 6961, 6966, 6975, 6985, 8000, 8007, 8026, 8027, 9045, 9046, 9078, 9079, 9100, 9122, 9144, 9152, 9164, 9168, 9170, 9172, 9188, 9196, 9198, 9200, 9302, 9311

Land Degradation focal area

5 The selection is limited to global and regional initiatives for most focal areas. However, national projects were considered in the focal areas Biodiversity, Climate Change, and Chemicals and Waste (where a large part of the investment has gone into national initiatives). All International Waters, Persistent Organic Pollutants and Chemicals and Waste projects were considered. In the case of Land Degradation, Biodiversity and Climate Change projects, and multifocal projects, the following keywords were used to search the GEF project database for relevant projects: "water", "sediment", "pollutant", "pollution", "fish", "fisheries", "river", "basin", "lake", "wetland", "groundwater", "aquifer", "delta", "estuary", "estuaries", "coast", "sea", "ocean", "ABNJ", "integrated". "Sustainable land management" and "SLM" were also used to search in the Land Degradation focal area and "adaptation" to search in the Climate Change focal area). In the case of national Climate Change projects, projects focusing primarily on mitigation were excluded.

Scale	GEF project ID number
Global (3)	2441, 4922, 5724
Regional (6)	1431, 2139, 2377, 2757, 3395, 3403

Biodiversity focal area

Scale	GEF project ID number
Global (1)	4930
Regional (9)	1028, 1092, 1097, 1258, 1490, 2686, 2906, 3750, 4260
National (83)	3, 668, 780, 838, 942, 1056, 1068, 1098, 1126, 1128, 1145, 1152, 1174, 1185, 1189, 1200, 1201, 1217, 1221, 1234, 1236, 1257, 1261, 1273, 1505, 2035, 2104, 2105, 2491, 2638, 2765, 2766, 2881, 2924, 3021, 3279, 3428, 3465, 3518, 3532, 3548, 3550, 3607, 3661, 3670, 3729, 3816, 3826, 3862, 3863, 3865, 3910, 3936, 3941, 3954, 3956, 4090, 4105, 4175, 4356, 4637, 4646, 4653, 4655, 4662, 4708, 4716, 4730, 4760, 4770, 4810, 4811, 4836, 4849, 4870, 4896, 5062, 5088, 5112, 5132, 5665, 5749, 5759

Climate Change focal area

Scale	GEF project ID number
Global (6)	874, 2553, 2774, 2939, 5683, 5868
Regional (13)	1060, 1084, 2552, 2614, 2902, 3101, 5113, 5228, 5388, 5667, 5681, 5723, 5815
National (111)	2019, 2543, 2931, 3159, 3219, 3227, 3242, 3243, 3249, 3265, 3267, 3287, 3302, 3408, 3430, 3581, 3684, 3689, 3694, 3695, 3701, 3703, 3704, 3716, 3733, 3838, 3857, 3885, 3893, 3963, 3967, 4018, 4019, 4141, 4222, 4234, 4255, 4261, 4276, 4318, 4368, 4422, 4434, 4453, 4492, 4536, 4551, 4568, 4599, 4610, 4700, 4701, 4714, 4724, 4725, 4822, 4901, 4950, 4960, 4971, 4991, 4992, 4993, 4994, 4995, 5002, 5003, 5004, 5006, 5015, 5021, 5049, 5071, 5075, 5105, 5115, 5124, 5177, 5190, 5194, 5204, 5209, 5211, 5230, 5279, 5280, 5318, 5328, 5332, 5358, 5382, 5411, 5417, 5456, 5462, 5489, 5504, 5523, 5604, 5632, 5636, 5666, 5687, 5694, 5702, 5703, 6927, 6945, 6955, 9107, 9210

Multifocal

Scale	GEF project ID number
Global (6)	4580, 4581, 4660, 4856, 9060, 9077
Regional (27)	947, 1022, 1082, 1420, 1537, 2095, 2132, 2364, 2505, 2517, 2600, 2601, 2929, 3398, 3399, 3423, 3589, 3591, 3749, 3779, 3782, 3822, 4029, 4620, 4635, 4680, 4750, 4764, 4932, 4953, 5133, 5384, 5395, 5487, 6920, 6970, 9070, 9094

APPENDIX 2. SELECTION OF REGIONAL GEF PROJECTS GROUPED BY SOURCE-TO-SEA SYSTEM[1]

Recipient LME	International Waters projects – large marine ecosystem (incl. Fisheries)	International Waters projects – river basin, lake basin and aquifer	Multifocal projects	Biodiversity projects	Land Degradation projects	POPs and Chemicals/ Waste projects	Climate Change projects
Canary Current	1909: Canary Current LME (3558: West Africa Regional Fisheries Program)	1109: Senegal River Basin 2706: IWRM in Atlantic and Indian Ocean SIDS	1420: Senegal and Niger River Basins – Reducing POPs and other Agrochemicals 5133: Senegal River Basin – Climate Change		1431: Fouta-Djallon Highlands INRM		2614: CC Adaptation, Shoreline Change
Guinea Current	1188: Guinea Current LME (3558: West Africa Regional Fisheries Program)	1093, 5535: Niger River Basin and (5535) the Iullemeden Taoudeni Tanezrouft Aquifer System (ITTAS) 1111, 6964: Volta River Basin 1017: Lake Tanganyika	1022: Integrated Ecosystem Management of Transboundary Areas between Niger and Nigeria 1420: Senegal and Niger River Basins – POPs and Other Agro-chemicals 5487: Niger Basin: Increased Rural Climate Resilience 4953: Mano River Union Ecosystem Conservation and IWRM 3779, 3882, 3822: Congo Basin CBSP – Sustainable Forest and Timber Management	2906: CBSP Sustainable Financing of Protected Area Systems in the Congo Basin 3750: CBSP Lake Tele-Lake Tumba (LTLT) Transboundary Wetland Landscape – Sustainable Forest Management	1431: Fouta-Djallon Highlands INRM		

1 Regional projects identified in Appendix 1 with a clear geographical link to a particular source-to-sea system were grouped according to recipient LME or endorheic system.

Recipient LME	International Waters projects – large marine ecosystem (incl. Fisheries)	International Waters projects – river basin, lake basin and aquifer	Multifocal projects	Biodiversity projects	Land Degradation projects	POPs and Chemicals/ Waste projects	Climate Change projects
Benguela Current	789, 3305, 5753: Benguela Current LME	970, 4966: Groundwater Management in SADC 2701, 9054: Orange-Senqu River Basin					5113: Climate Change Resilience in the Benguela Current Fisheries System
Aghulas and Somali Current	1247, 4940: Western Indian Ocean – Land-based Activities (WIO-LaB and WIO-SAP) 1462, 5513: Agulhas and Somali Current LMEs (ASCLME and SAPPHIRE) 2098: Western Indian Ocean Marine Highway Development and Coastal and Marine Contamination Prevention Project (5905: West Indian Ocean Fisheries – SWIOFish1)	2706: IWRM in Atlantic and Indian Ocean SIDS 970, 4966: Groundwater Management in SADC	(1082: Southwest Indian Ocean Fisheries Project – SWIOFP)				
Red Sea	3809: Red Sea and Gulf of Aden Strategic Ecosystem Management						

Recipient LME	International Waters projects – large marine ecosystem (incl. Fisheries)	International Waters projects – river basin, lake basin and aquifer	Multifocal projects	Biodiversity projects	Land Degradation projects	POPs and Chemicals/ Waste projects	Climate Change projects
East Asian Seas (South China Sea Gulf of Thailand Sulu-Celebes Sea Indonesian Seas East China Sea Yellow Sea)	2700, 5405: Implementation of Sustainable Development Strategy for the Seas of East Asia (SDS-SEA) 2454, 3025: LMEs of East Asia – World Bank/GEF Partnership Investment Fund for Pollution Reduction 4936: (PROGRAM) EAS East Asian Seas Implementation of Intergovernmental Agreements and Catalysed Investments (5393: Sustainable Management of Highly Migratory Fish Stocks in the West Pacific and East Asian Seas)		4635: (PROGRAM) LME-EA Scaling Up Partnership Investments for Sustainable Development of the LMEs of East Asia and their Coasts				
Yellow Sea	790, 4343 (EAS): Yellow Sea LME						
South China Sea and Gulf of Thailand	885, 5401 (fisheries refugia), 5538: South China Sea and Gulf of Thailand	2138: Livestock Waste Management in East Asia	3589: CTI Southeast Asia under Coral Triangle Initiative	1490: Mekong River Basin Wetland Biodiversity Conservation and Sustainable Use			
Sulu-Celebes Sea	3524: CTI Sulu-Celebes Sea Sustainable Fisheries Management 3619: CTI Strategies for Fisheries Bycatch Management		3589: CTI Southeast Asia under Coral Triangle Initiative				

Recipient LME	International Waters projects – large marine ecosystem (incl. Fisheries)	International Waters projects – river basin, lake basin and aquifer	Multifocal projects	Biodiversity projects	Land Degradation projects	POPs and Chemicals/ Waste projects	Climate Change projects
Indonesian Sea	5768: Indonesian Seas 3522: CTI Arafura and Timor Seas under the Coral Triangle Initiative 3619: CTI Strategies for Fisheries Bycatch Management		3589: CTI Southeast Asia under Coral Triangle Initiative 6920: Arafura and Timor Seas SAP Implementation				
North Australian Shelf	3522: CTI Arafura and Timor Seas under the Coral Triangle Initiative 3619: CTI Strategies for Fisheries Bycatch Management		6920: Arafura and Timor Seas SAP Implementation				
Pacific Warm Pool	(2131: Pacific Islands Oceanic Fisheries Management Project) (4746: Pacific SIDS – Global and Regional Oceanic Fisheries Conventions and Related Instruments) (5393: West Pacific and East Asian Seas – Highly Migratory Fish Stocks)	2586: PAS: IWRM and Wastewater Management in the Pacific Island Countries 5404: R2R: Pacific Island Countries	3591: PAS: Coral Triangle of the Pacific – Coastal and Marine Resources Management in the 5395: R2R- Pacific Islands Ridge-to-Reef National Priorities 6970: Pacific Islands Regional Oceanscape Program (PROP)			4066: PAS: Pacific POPs Release Reduction	3101: Pacific Adaptation to Climate Change Project (PACC)
Bay of Bengal	1252: Bay of Bengal Large Marine Ecosystem 1270: Marine Electronic Highway Demonstration						

Recipient LME	International Waters projects – large marine ecosystem (incl. Fisheries)	International Waters projects – river basin, lake basin and aquifer	Multifocal projects	Biodiversity projects	Land Degradation projects	POPs and Chemicals/ Waste projects	Climate Change projects
Kara Sea			4029: Integrated Natural Resource Management in the Baikal Basin Transboundary Ecosystem				
Caspian Sea	1618, 3620: Caspian Sea LME	1375, 6962: Kura-Aras Basin					
Baltic	922: Baltic Sea LME						
Black Sea	1580, 2263: Black Sea LME – Control of Eutrophication, Hazardous Substances	1014, 1661, 2044: Danube/ Black Sea Basin Strategic Partnership on Nutrient Reduction 1460, 2042: Danube Regional Project – Nutrient reduction 2544: Dnipro Basin – persistent toxics pollution					

Recipient LME	International Waters projects – large marine ecosystem (incl. Fisheries)	International Waters projects – river basin, lake basin and aquifer	Multifocal projects	Biodiversity projects	Land Degradation projects	POPs and Chemicals/ Waste projects	Climate Change projects
Mediterranean	3229: WG-GEF MED Investment Fund for the Mediterranean Sea LME 3977: MED Mediterranean Environmental Sustainable Development 3990: MED Mediterranean Integration of Climatic Variability and Change – Implementation of ICZM Protocol 3900: (Global) MENARID – GEF IW LEARN 4001: (Global) MED – Sustainable Governance and Knowledge Generation 5269: Adriatic Sea Environmental Pollution Control	3978: MED: Water Resources Management and Capacity Building (H-APL)(TA) 2133: Lake Skader-Shkoder 3690: Dinaric Karst Aquifer System 4483, 5566: Drin River 1094, 2584: Nile River 5674: Lakes Edward and Albert	2132: WB-GEF MED Neretva and Trebisnjica Rivers 2600: Strategic Partnership for the Mediterranean Large Marine Ecosystem-Regional Component 2601: World Bank-GEF Investment Fund for the Mediterranean Sea LME 1537: Prespa Lakes Basin 3398: SIP: Eastern Nile ENSAP Implementation 3399: SIP: Lake Victoria		2139: SIP: Kagera River Basin – Agro-Ecosystem Management (Kagera TAMP)		5723: Drin River Basin

Recipient LME	International Waters projects – large marine ecosystem (incl. Fisheries)	International Waters projects – river basin, lake basin and aquifer	Multifocal projects	Biodiversity projects	Land Degradation projects	POPs and Chemicals/ Waste projects	Climate Change projects
Caribbean Sea	963: Gulf of Honduras 1032, 5542: Caribbean LME and Adjacent Regions, CMLE+ (5542) (5304: Bycatch in Latin America and Caribbean Trawl Fisheries (REBYC-II LAC))	1248: Pesticide Run-off to the Caribbean Sea 1254: Caribbean SIDS – IWCAM 3766: Prototype Caribbean Regional Fund for Wastewater Management (CReW) 5765: Mesoamerican Reef – Ridges-to-Reef Management	2517: Sixaola River Basin 2929: Artibonite River Basin 4932: Caribbean SIDS – Integrating Water, Land and Ecosystems Management			5407, 5558: Caribbean POPs and Pesticides Management	2552: Coastal areas of Dominica, St. Lucia and St. Vincent & the Grenadines - Pilot Adaptation Measures 5667: CC Adaptation in the Eastern Caribbean Fisheries Sector
North Brazil Shelf	5542: Caribbean and North Brazil Shelf Large Marine Ecosystems (CMLE+)		2364: Amazon River Basin				
Patagonian Shelf		886: Bermejo River Binational Basin 974: Guarani Aquifer 3519: Rio de la Plata/ Maritime Front - Reducing and Preventing Land-based Pollution	2095: The la Plata Basin 2505: Gran Chaco American Ecosystem - SFM Sustainable Forest Management				
Humboldt Current			3749: Humboldt Current LME				

Recipient LME	International Waters projects – large marine ecosystem (incl. Fisheries)	International Waters projects – river basin, lake basin and aquifer	Multifocal projects	Biodiversity projects	Land Degradation projects	POPs and Chemicals/ Waste projects	Climate Change projects
Pacific Central American Coastal		5284: Puyango-Tumbes, Catamayo-Chira and Zarumilla Transboundary Aquifers and River Basins					
Gulf of California		791: San Juan River Basin and its Coastal Zone					
Endorheic systems	International Waters projects – large marine ecosystem (inc. Fisheries)	International Waters projects -river basin, lake basin and aquifer	Multi-focal projects	Biodiversity projects	Land Degradation projects	POPs and Chemicals/ Waste projects	Climate Change projects
Lake Chad		767, 4748: Lake Chad					
Aral Sea		5301: Syr Darya Basin - Ground Water	9094: Central Asia and Turkey - INRM in Drought-prone and Salt-affected Agricultural Production Systems (CACILM2)		2377: High Pamir and Pamir-Alai Mountains		
Okavango		842, 5526: Okavango River/ Delta					
Titicaca-Desaguadero-Poopo-Salar de Coipasa (TDPS) System		5284, 5748: IWRM in the TDPS system					

CASESTUDIES

Region	Case
Asia and the Pacific	Collaboration in the Seas of East Asia Focus on GEF International Waters investment for the Partnerships on Environmental Management in the Seas of East Asia.
Asia and the Pacific	Bay of Bengal Large Marine Ecosystem Focus on the Bay of Bengal Large Marine Ecosystem project
Europe and Central Asia	Danube River and Black Sea Collaboration Focus on GEF International Waters investment for Black Sea nutrient reduction.
Europe and Central Asia	Baltic Sea Collaboration Focus on the process in relation to 1992 Convention on the Protection of the Marine Environment of the Baltic Sea Area, the 2007 Baltic Sea Action Plan, the 2008 EU Strategy for the Baltic Sea Region, and the EU Water Framework and Marine Strategy Framework Directives
Latin America and Caribbean	Caribbean Small Island Developing States (SIDS) and Links to the Larger Caribbean Sea Basin – Integrated Watershed and Coastal Area Management Focus on GEF International Waters investment to support integrated watershed and coastal area management in the Small Island Developing States of the Caribbean.
North and Latin America (US-Mexico)	Colorado Basin, its Delta and the Upper Gulf of California Focus on the processes related to the 1944 US-Mexico Water Treaty, its Minutes 242 (1973) and 319 (2010), the Upper Gulf of California and Colorado River Delta Biosphere Reserve, and governance arrangements in the Gulf of California.

A3A.
COLLABORATION IN THE SEAS OF EAST ASIA – PARTNERSHIPS IN ENVIRONMENTAL MANAGEMENT OF THE SEAS OF EAST ASIA (PEMSEA)

Author: Anna Tengberg[1]

The East Asia Seas (EAS) region encompasses a series of LMEs and sub-regional seas and their coastal areas. The LMEs includes the Yellow Sea, the East China Sea, the South China Sea, the Gulf of Thailand, the Sulu-Celebes Sea and the Indonesian Seas – all of great ecological and economic importance. Major associated river systems within the EAS region are the Mekong, the Yangtze, the Yellow and the Red. The region is the most densely populated on earth. It is subject to habitat destruction, notably of coral reefs, mangroves and seagrass beds; pollution, including hazardous waste and sewage; and other threats to coastal and marine ecosystems, such as loss of fisheries production and emerging impacts of climate change. From a source-to-sea perspective, land use transformation and sedimentation in coastal and upland areas caused by expansion of agriculture and deforestation are important drivers of environmental degradation. [1]

1 This case study includes insights from (Tengberg and Cabanban, 2013).

Enabling conditions

For more than 20 years, the GEF has provided significant investments to assess and improve the status of the LMEs in the EAS region. Strategic action programmes are approved for the Yellow Sea, South China Sea, the Sulu-Celebes (Sulawesi) Sea and the Arafura-Timor Seas (at the intersection of the Indonesian Seas and the North Australia Shelf LME). A TDA/SAP process is also under way for the Indonesian Seas. In addition, the Sustainable Development Strategy for the Seas of East Asia (SDS-SEA) provides an overarching framework for action in all the LMEs in the EAS. It has the following targets:

1. a self-sustaining regional partnership mechanism for implementation of the strategy;

2. national coastal and oceanic policies supporting institutional arrangements in at least 70 percent of partners countries

3. integrated coastal management programmes for sustainable development of coastal and marine areas and climate change adaptation covering at least 20 percent of the region's coastline; and

4. a report prepared on the progress of ICM programmes every three years, including on measures taken for climate change adaptation

The SDS-SEA identifies ICM as a practical framework for sustainable development as the approach expands from coastal and marine management to encompass watersheds, river basins and other associated ecosystems. Formal commitments to implement the SDS-SEA and to reach its targets include the establishment of PEMSEA, which started out as a GEF-funded regional pilot programme, Prevention and Management of Marine Pollution in the East Asian Seas, from 1994–1999, followed by a second phase on Building PEMSEA. This second phase focused on integrating local, national and international initiatives to address coastal and marine issues and resulted in the adoption the SDS-SEA. PEMSEA's third phase started in 2008 and focused on the implementation of the SDS-SEA, which continues in the fourth phase that started in 2014. PEMSEA has also contributed to the establishment of the World Bank/GEF Partnership Investment Fund for Pollution Reduction in the LMEs of East Asia. The objective of the fund is to leverage investments in reduction of land-based pollution discharges that are degrading the seas of East Asia by removing technical, institutional or financial barriers to such investments.

The regional governance arrangements of PEMSEA are the East Asian Seas Partnership Council and its Intergovernmental Session, which is made up of PEMSEA member countries; its Technical Session, which also include non-country partners; and the PEMSEA Resource Facility (PRF), based in Manila, Philippines. The PRF provides secretariat and technical services related to SDS-SEA implementation to the EAS Partnership Council. PEMSEA's governance mechanism also includes a triennial East Asian Seas Congress and Ministerial Forum, which ensures wide stakeholder participation and knowledge exchange. Furthermore, a PEMSEA Network of Local Governments for Sustainable Coastal Development has been set up, and in 2006 adopted its own charter and established a secretariat, hosted by the Xiamen Municipal Government. The Third Ministerial Forum of the EAS Congress (Manila, 26 November 2009) established PEMSEA as an independent regional mechanism mandated for the implementation of the SDS-SEA. Evaluations have called PEMSEA an innovative attempt to integrate local, national and international initiatives to address coastal and marine issues on habitat degradation, unsustainable rates of resource use and resource use conflicts, hazards and the conditions of poverty. However, in 2012 a GEF evaluation of the impacts of its work in the South China Sea and adjacent areas expressed concern that after 20 years of support, PEMSEA remained heavily dependent on GEF funding (GEF, 2012).

PEMSEA's 11 country partners are Cambodia, PR China, Indonesia, Japan, DPR Korea, Lao PDR, Philippines, RO Korea, Singapore, Timor-Leste, and Vietnam. Its 20 non-country partners include a wide array of entities, ranging from international, regional and national organizations and projects to local governments. There is a complex overlap of mandates and geographical coverage between different initiatives and mechanisms at the regional level in the EAS region. Recently, fisheries management organizations have been invited to join PEMSEA, including the Western and Central Pacific Fisheries Commission, but there is still no river basin organization that is a partner. Moreover, of the regional seas programmes, only the Northwest Pacific Action Plan has joined PEMSEA, while the Coordinating Body on the Seas of East Asia (COBSEA), which oversees the Action Plan for the Protection and Development of the Marine and Coastal Areas of the East Asian Region, is only an observer.

COBSEA provided an institutional platform for a GEF-funded project for the South China Sea that was completed in 2009. According to the GEF Impact Evaluation as well as the terminal evaluation of the South China Sea project, there has been a lack of synergies between the regional seas and South China Sea interventions on the one hand, and the PEMSEA interventions on the other. This is also reflected in poor coordination at the national level in cases where there are different national partner agencies that do not interact. There is also a lack of coordination with the regional programme initiated by COBSEA on marine litter, which is an important source-to-sea flow that could be linked to PEMSEA ICM demonstrations in watersheds and river basins.

Behavioural change

A review by PEMSEA of the implementation of the SDS-SEA from 2003 to 2015 indicates that it is on course to reach its targets. According to PEMSEA:

1. Good progress has been made in achieving the full functionality of PEMSEA through the establishment of an international organization with its own legal personality and governance system. However, as noted above, concerns have been expressed about its financial sustainability.

2. Eighty-four percent of the countries have developed and implemented national policies, strategies, action plans and programmes in coastal and ocean management and river basin management. Seventy-five percent of the countries have established national interagency and intersectoral coordination mechanisms for coastal and ocean management and river basin management (PEMSEA, 2015).

In Batangas, Philippines, the ICM programme started with five municipalities and one city in Batangas Bay. It has now been replicated to cover the entire watershed, coastal areas and bays of the province, through the efforts of the province in coordination with 34 local governments, agencies and donors. Recent developments in Vietnam and Thailand also point to ICM's growing resilience. Through the replication of useful practices, stakeholders across different political units join forces to systematically manage critical ecosystems that transcend administrative boundaries. It is through this approach that ICM becomes an important tool that combines the management of human activities with protecting the functional integrity of the primary ecosystems.

However, the GEF impact evaluation concludes that when it comes to scaling up of ICM, many of the PEMSEA sites face the classic upstream/downstream dilemma, whereby upland local government units will have to invest in activities that will largely benefit coastal local government units. There are therefore significant differences in the rate of adoption between coastal and upland municipalities, as the incentives for upland adoption of ICM are not so compelling.

3. In June 2015, it was estimated that countries have scaled up ICM programmes to cover 14 percent of the coastline of the region's 234,000 km coastline. This has been underpinned by the strengthening of institutional and individual capacity and establishment of a number of ICM learning centres in the EAS region.

   Different management approaches, such as integrated river basin management, ICM and IWRM are often implemented jointly and PEMSEA's demonstration project in Laos provides a good example of this. The Sedone Integrated River Basin Management Project (SIRBMP) is the first project in southern Laos that promotes an interprovincial and multisectoral approach to manage the resources in a river basin, and is a collaborative effort among the three provinces, the Department of Water Resources and PEMSEA. The SIRBMP provides capacity development in rapid appraisal, river basin strategy development, information management and other activities.

   PEMSEA has not yet managed to forge a partnership with the Mekong River Commission (MRC) or other river basin entities, which could make its demonstration activities in upstream/upland areas even more strategic and enhance opportunities for replication among local government entities. However, the World Bank-implemented MRC Water Utilization Project helped the MRC to establish mechanisms to improve coordinated, sustainable water management in the Mekong River Basin. The project supported the development and negotiation of a set of rules to help facilitate implementation of the Mekong agreement. The project also helped facilitate MRC engagement with non-MRC members China and Myanmar.

4. Progress has also been made with ICM progress reporting and the first country and regional review of SDS-SEA implementation was prepared in 2011 and the second in November 2015. In addition, state of coast reports are being initiated or completed in 29 local governments.

With respect to investments, many of the projects and programmes in the EAS with links to PEMSEA that address water pollution and/or eutrophication are funded under the World Bank/GEF Pollution Reduction Investment Fund and are concentrated in the Yellow Sea and the South China Sea. According to the 2010 progress report of the Investment Fund, it has made good progress in launching pollution reduction projects with high demonstration value and leverage of co-financing with an average ratio of 1:20. PEMSEA's efforts to foster public-private partnerships to create investment opportunities in support of ICM in, for example, solid waste management facilities and water treatment and sewerage systems, have had more mixed results.

Projects that address water resources management issues are found in both the Mekong basin and coastal areas, while projects addressing threats to habitats are concentrated in the South China Sea, the Sulu-Celebes Sea and the Arafura-Timor Seas. Those addressing overexploitation of fisheries mainly deal with coastal fisheries, and only one project deals with oceanic fish stocks. Projects addressing climate change impacts are focused on least-developed countries in the region and Timor-Leste and Cambodia receive funding for coastal zone adaptation through the Least-Developed Countries Fund. However, these investments are heavily dependent on GEF resources.

Achievement of source-to-sea related goals/targets

The 2012 GEF Impact Evaluation in the South China Sea and adjacent areas (concluded that GEF-supported approaches have generally been effective at the specific sites where they have been implemented, but that the extent of stress reduction often has been limited because of larger-scale factors that the demonstration projects could not address, such as land-based pollution from tourism and agriculture. Nevertheless, environmental stress reduction in terms of reduction in pollutant discharges and improved water quality has been achieved at some demonstration sites, such as Xiamen (China) and Chonburi (Thailand). PEMSEA has also been instrumental in the integration of ICM principles and strategies in the national policy frameworks of member countries, as discussed above.

Opportunities to achieve source-to-sea goals/targets at GEF portfolio level

PEMSEA already works together with a large number of projects in the GEF portfolio in the EAS region. Where links to other coastal and marine management projects are weak, this often depends on the entrenched roles and unwillingness of GEF agencies to cooperate. Better linkages and exchanges with GEF programmatic approaches in terrestrial and inland ecosystems and other focal areas could foster a better understanding of key source-to-sea flows from uplands to the coastal and marine environment, and of how to link different management approaches used along the continuum from SLM and SFM in upstream areas, to IWRM in freshwater systems, to ICM in coastal areas and marine spatial planning in near-shore areas and LMEs. This could include closer cooperation with, for example, the PRC-GEF Land Degradation Partnership in Dryland Ecosystems, that has largely focused on promoting SLM in the Yellow River Basin, closer collaboration with projects in the Mekong River Basin and the MRC as well as with projects in other river basins, such as those of the Yangtze and the Red.

Conclusions

Strengthening policy frameworks and governance mechanisms for critical flows between segments in the source-to-sea continuum in the EAS region could, to some extent, be managed across existing programmes, coordination mechanisms and management frameworks. This could ensure cross-sectoral collaboration between ministries such as environment, agriculture, fisheries, economy, finance, public works, and other sectors, as well as of local government entities situated along the source-to-sea continuum.

As suggested by the GEF Transboundary Waters Assessment, common indicators of drivers of change linking different water systems also need to be identified. They could include indicators for discharge, nutrients/eutrophication, climate change, sediment loads, etc. This would in turn help harmonize the different management approaches applied along the source-to-sea continuum, such as ICM in coastal areas, IWRM in freshwater systems, and SLM and SFM in upland terrestrial ecosystems, in order to ensure that management interventions along the continuum work towards a common goal. Finally, incentive mechanisms to deal with upstream-downstream linkages across segments are also needed to bring on board government entities in upland/upstream areas and to promote replication and scaling up.

Sources

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A3B.
BAY OF BENGAL LARGE MARINE ECOSYSTEM

Author: Anna Tengberg

The Bay of Bengal Large Marine Ecosystem is one of the largest LMEs globally and covers 6.2 million km2. About 66 percent of the BOBLME lies within the exclusive economic zones of BOBLME countries – Bangladesh, India, Indonesia, Malaysia, Maldives, Myanmar, Sri Lanka, and Thailand – the remainder being high seas.

Enabling conditions

In the BOBLME the creation of enabling conditions for ecosystem-based management, including management of some key source-to-sea flows, was initiated by development of a transboundary diagnostic analysis. Regional working groups were constituted to develop the TDA and the project provided a forum for bringing scientists and policy-makers together for a dialogue on the threats to the BOBLME.

The TDA identified three priority transboundary concerns:

Overexploitation of marine living resources. This includes decline in overall fish resources, and changes in marine biodiversity, especially through loss of vulnerable and endangered species. The proximate causes of these problems are excessive fishing and overcapacity; destructive and unselective fishing practices and gear; and illegal, unregulated and unreported fishing. These in turn are caused by the "open access" regime; government emphasis on increasing production; inappropriate subsidies; increasing fishing activity; high consumer demand for fish; weak fisheries monitoring, control, and surveillance and enforcement; and strong incentives to encroach into protected or environmentally sensitive areas that offer better returns.

Degradation of critical habitats. This includes mangroves, coral reefs and seagrasses. Over 4,500 km2 of mangroves have been lost in the region over the last 30 years. The major cause of loss of mangroves has been conversion for agriculture (82 percent) and aquaculture (12 percent). Coral reefs are also classified as degraded or under threat. There is insufficient information to assess the status of seagrass, although it is thought that many of the BOBLME region's seagrass beds are either already degraded or threatened. Seagrass beds are mainly threatened by sedimentation and eutrophication, destructive fishing practices, and coastal modification, including dredging and mining for sand.

Pollution and water quality. The priority transboundary pollution issues in the BOBLME are sewage-borne pathogens, organic load from sewage and other sources, marine litter, nutrient pollution, oil pollution, POPs and persistent toxic substances, and mercury pollution. The effects of pathogens and high organic loads are likely to be localized except in the Ganges-Brahmaputra-Meghna system where sewage and other organic contaminants are shared by India, Bangladesh and Myanmar due to high river discharge and ocean circulation patterns.

The proximate causes of these problems are the widespread discharge of untreated or inadequately treated domestic, industrial and agricultural wastewater; inadequate solid waste management, including widespread discharge of solid waste into rivers and coastal waters and the open burning of solid waste which generates dioxins and furans; increasing emissions of nutrients from fertilizer use in agriculture, expanding aquaculture; atmospheric emissions from industry and fossil fuel burning; and routine operational discharges of oil from shipping and dumping of waste oil by vessels and vehicles on land.

Important source-to-sea flows identified in the BOBLME thus include flows of sediments, pollutants and marine litter into the Bay of Bengal from some of the world's largest river systems, and two-way biological flows of fish and other organisms between the freshwater and marine environment.

A strategic action programme for the BOBLME project was agreed in March 2015. Targets by 2025 related to source-to-sea flows for each SAP component include:

Component 1 on marine living resources – a number of targets related to increase abundance and biomass of fish, which are relevant to biological flows from marine into freshwater systems;

Component 2 on critical habitats – 10 percent of lost mangroves restored, as well as targets for coral reef and seagrass habitats important for physical as

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well as biological flows from the marine to the coastal environment. Mangroves plays a role for flows in both directions, as they act as traps for sediments and pollutants transported downstream, and at the same time provide nursery and spawning ground for fish. In addition, they are important stocks of blue carbon and can capture atmospheric flows of CO2;

Component 3 on water quality – includes a number of targets of relevance to source-to-sea flows: 5 percent increase in the numbers of urban and coastal town connections to municipal or on-site sewage treatment systems; 100 percent of effluent discharged from sewage treatment systems is treated to meet national wastewater quality standards; 5 percent reduction in solid waste disposal; 5 percent reduction in plastic and e-waste; establishment of solid waste management systems in coastal regions; extended producer responsibility established for recyclable solid wastes; nutrient use efficiency at the source in agriculture, aquaculture and other nutrient generating industries improved by 10 percent; 50 percent reduction of nitrates and phosphates entering the BOBLME from wastewater; and 100 percent of sludge recovered and safely re-used;

Component 4 on social and economic considerations – relevant for socio-economic flows in the source-to-sea continuum, especially targets related to climate change adaptation and risk reduction, improved working and living conditions, and participation of both men and women in decision-making processes.

The final evaluation of the first phase of BOBLME concluded that the project developed reasonable formal and informal collaboration among the eight countries. Formal commitments to address the priorities of the SAP, including some critical source-to-sea flows, include:

It has been agreed that a Consortium for the Conservation and Restoration of the BOBLME (CCR-BOBLME) will be established as the regional intersectoral mechanism to address transboundary and regional threats. It will include representations from the environment and fisheries sectors in each of the eight countries; from regional bodies and programmes, such as South Asia Co-operative Environment Programme, the Bay of Bengal Programme Inter-Governmental Organization, the International Collective in Support of Fishworkers, the Southeast Asian Fisheries Development Center, Mangroves for the Future, the Network of Aquaculture Centres in Asia; from multilateral partners in the BOBLME, such as IUCN, UNEP and the UN Industrial Development Organization (UNIDO); and from the National Oceanic and Atmospheric Administration of the United States, and the governments of Norway and Sweden.

National inter-ministerial committees will be established in Phase II of the programme based on national priorities and roles and responsibilities identified in the BOBLME SAP. The nucleus of these committees already exists and is comprised of ministries of environment and ministries of fisheries or their equivalent. However, the final evaluation concludes that in Phase I there was too strong a focus on fisheries at the expense of other sectors.

Decentralization of management authority to the appropriate level has been agreed, and is to be achieved through, for example, strengthening of ICM committees, and strengthening of linkages between local, district, state and central authorities for regulating matters of pollution and water quality. It could also include improved intersectoral collaboration in establishment of coastal and marine managed areas and marine spatial planning. However, according to the final evaluation, Phase I did not do enough to produce and implement local-level ICM and critical habitat management plans.

Behavioural change

The BOBLME programme was based on the need to lay the foundations for change, including demonstrations of transboundary cooperation, before implementing a second phase action programme that will lead to the long-term goal relating to an improvement in the health of the Bay of Bengal and its fisheries. Phase I focused on:

1. increasing capacity in natural resources management,
2. increasing knowledge about the ecosystem,
3. developing indicators for tracking changes, and
4. improving ecosystem health through transboundary demonstration activities.

It is therefore still early to assess behavioural change among BOBLME stakeholders and decision-makers. However, it is significant that for the first time, the environment and fisheries sectors are collaborating in identifying actions and investments to ensure the sustainable management of the BOBLME through an agreed SAP that includes environmental targets as well as management actions. Initial governance arrangements are in place for implementing the SAP, but the focus is not specifically on source-to-sea flows. Institutional capacity is nevertheless being developed at both regional and national levels to address key flows of nutrients and other pollutant flows from both point and non-point sources in the coastal zone.

However, upstream linkages beyond the coastal zone in relevant river basins have not been identified, including how to link different but related management approaches, such as habitat management and ICM in the coastal zone, IWRM in the freshwater system, and SLM and SFM in upstream terrestrial ecosystems important for controlling sediment and nutrient flows to the coastal zone.

The programme has not yet reached the stage where major changes in investments are taking place, but governments are expected to provide significant financing to implementation of national goals and targets under the SAP, and discussions are also on-going with financial institutions to join the programme to contribute to the pollution reduction component of the SAP.

Achievement of source-to-sea related goals/targets

The SAP targets outlined above are expected to be achieved by 2025, but a number of process-related targets have already been reached, such as: agreement on the SAP by all eight BOBLME countries; signature of the SAP at ministerial level by both fisheries and environment ministries in six countries;2 establishment of national and local-level governance processes and mechanisms; and, based on economic valuation undertaken by the project, increased awareness of the ecosystem services delivered by the BOBLME, some of which are linked to the

2 One ministry has signed in a seventh country, while the last country is waiting for both signatures.

critical source-to sea-flows already discussed. However, it remains to be seen if actions linked to critical source-to-sea flows will be targeted and if links will be developed between different source-to-sea segments that will result in coordinated and harmonized management approaches and actions.

Opportunities to achieve source-to-sea goals/targets at GEF portfolio level

Source-to-sea flows cut across not just TDA/SAP themes and priorities, sectors and jurisdictions, but also the priorities and focal areas of the GEF itself. It may therefore not always be possible to manage a key source-to-sea flow in a single project, especially at scales where the flow continues all the way from terrestrial ecosystems in upper watersheds to the open ocean. Our review therefore made a quick assessment of the larger GEF portfolio in the BOBLME region and identified the following opportunities for GEF to strengthen its approach and management of source-to-sea flows:

- Enhance linkages to GEF climate change adaptation projects in the coastal zone and rivers, such as the Least-Developed Countries Fund projects in Bangladesh and Myanmar on community-based climate-resilient fisheries and aquaculture development. For example, the Bangladesh project is working in both the south-western coastal zone, which is affected by sea-level rise and salt water intrusion, and the north-eastern *haor* basin (an internationally important wetland area, consisting of back swamps or *haor*), which is affected by increased incidence of floods in the Brahmaputra Basin and contributes important flows to the BOBLME.

- Enhance linkages to GEF land degradation/SLM projects, such as the SLM project in the Central Highlands of Sri Lanka, which have extremely high erosion rates, with sediment ultimately reaching the BOBLME through the Mahaweli River.

- Enhance linkages to GEF biodiversity and SFM projects in the BOBLME that address issues related to habitat conservation. In particular, conservation of mangroves contributes to reach source-to-sea objectives in coastal areas and can influence biological, sediment, pollution and atmospheric flows.

Conclusions

Linkages between upstream and downstream systems in the source-to-sea continuum can be enhanced at several levels. Firstly, integrated management approaches, such as ICM, IWRM, SLM, SFM and marine spatial planning, could be better linked across selected critical flows and segments in the source-to-sea continuum to ensure coordinated and effective management. Secondly, better integration and linkages across focal areas of GEF-funded interventions could accelerate the GEF's impact on critical flows along the source-to-sea continuum and its ability to target flows of sediments and pollutants from terrestrial ecosystems and freshwater systems to the coastal and marine environment, as well as biological flows of fish and other organisms from coastal and marine areas to upstream areas. Finally, a method needs to be developed and pilot tested that can quickly identify and map critical source-to-sea flows based on available information such as TDAs and SAPs as well as other assessments and management plans. Such flows could then be fast-tracked for investment to reduce loss of critical ecosystem functions and services important for sustaining a healthy environment and for human well-being.

Sources

BOBLME TDA and SAP documents, and BOBLME terminal evaluation (http://www.boblme.org/); and review of GEF database of other relevant projects in the bay and adjoining river basins (https://www.thegef.org/gef/gef_projects_funding).

A3C. DANUBE RIVER AND BLACK SEA COLLABORATION

Authors: Birgitta Liss Lymer and Ivan Zavadsky

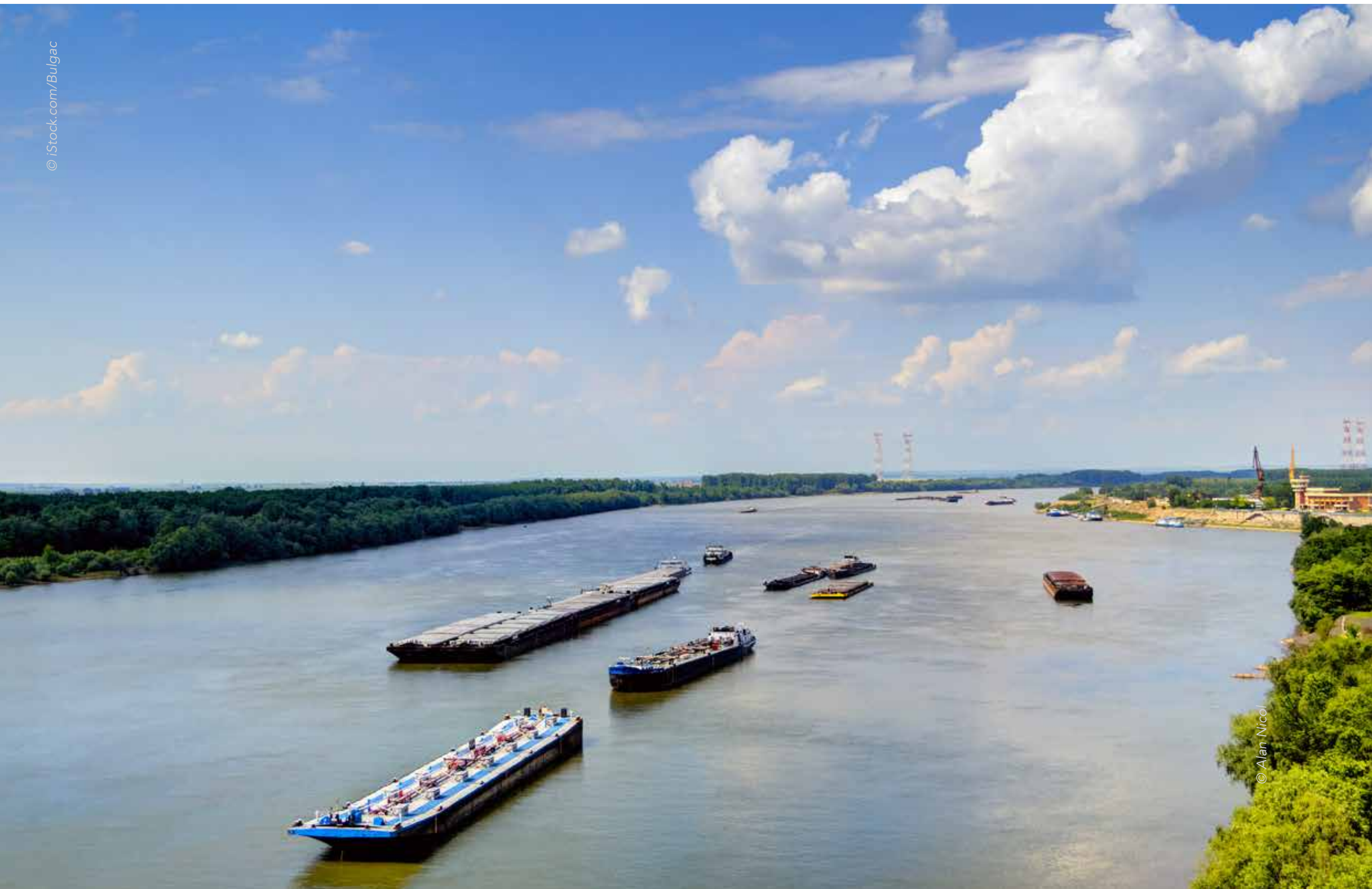
Introduction: The Black Sea

Until the 1960s, the Black Sea was known for its productive fishery, scenic beauty, and as a resort destination for millions of people. In the 1970s and 1980s, the ecosystem of the western Black Sea collapsed. Vast numbers of dead algae and other aquatic life covered the beaches of Romania and western Ukraine. Between 1973 and 1990, losses of bottom-feeding animals were estimated at 60 million tons, including five million tons of fish. In 1990, about 40,000 km2 of the north-western shelf of the Black Sea was effectively considered a dead zone, with insufficient levels of dissolved oxygen to support life. This resulted in a massive die-off, over time, of fish and other animal life. Over-fishing and introduction of invasive species have also contributed to the economic crisis in the Black Sea fisheries industry. High levels of pollution experienced in the 1970s and 1980s coincided with advances in the fishing industry, resulting in unregulated overexploitation. The number of exploitable fish species dropped from 26 to just six, over a period of only two decades.

The most significant process degrading the Black Sea has been eutrophication due to the massive flow into it of nitrogen and phosphorus, largely as a result of run-off from agricultural activities, and from municipal, domestic, and industrial sources. The nutrients come from sources in the 23 countries of the Black Sea drainage basin, particularly through the rivers. Besides eutrophication, and the resulting massive die-offs of freshwater and marine life, the nutrient flow also severely reduces the quality of water available for human use.

Enabling conditions

Prior to the 1990s, there had been little or no action taken to protect the Black Sea, largely due to a lack of knowledge of the environmental situation and political differences between the Black Sea countries during the Soviet era. Formal commitments to protect the Black Sea from pollution have since been made by countries on the Black Seas (the 1992 Bucharest Convention, which entered into force in 1994; the 1993 Odessa Declaration) and by countries along the Danube (the 1994 Danube River Protection Convention, which entered into force in 1998). Both conventions have a strong emphasis on pollution,



and the Danube River Protection Convention explicitly aims for protection of the Black Sea marine environment.

GEF investment in the Danube and Black Sea basins was initiated in the beginning of the 1990s. Activities were designed to support the implementation of the Bucharest and Danube River Protection Conventions, and to reinforce the activities of the International Commission of the Danube River (ICPDR) and the Black Sea Commission, when they were established.

Investment in the 1990s enabled the formulation of TDAs and SAPs to support the implementation of both conventions, while also setting in place cooperation between the initiatives in Black Sea and Danube River Basin. The objectives of the Black Sea SAP (1996, updated in 2007) are aimed at preserving commercial marine living resources, conserving Black Sea biodiversity and habitats, reducing eutrophication, and ensuring good water quality for human health, recreational use and aquatic biota. It identifies integrated coastal zone management, the ecosystem approach and integrated river basin management as key environmental management approaches to reach these objectives. The Danube River Basin SAP (1995, updated in 1999) was too narrow to be considered a comprehensive tool for ICPDR implementation, but was used to prepare the Joint Action Programme (JAP) of the ICPDR 2001–2005, which included as one of its general objectives to "contribute to reducing the pollution loads of the Black Sea from sources in the catchment area", aiming for improved ecological and chemical status of the water, prevention of accidental pollution events and minimization of the impacts of floods (ICPDR, 2000). In 2000, Danube countries agreed that the first priority for ICPDR for the coming years should be the implementation of the Water Framework Directive, a process that was supported by the GEF activities in the Danube River Basin. After having been identified as the transboundary issue with the greatest long-term impact on the Black Sea, eutrophication has been the main focus of GEF investment since the early 2000s. The overall GEF effort has been described as the "most ambitious nutrient management project in GEF history" (STAP, 2011).

In order to contribute to safeguarding Black Sea ecosystems from further deterioration, the Black Sea Commission and the ICPDR signed a memorandum of understanding in 2001, in which they agreed to common goals not only on reducing pollution loads, but also in a range of other areas: monitoring and sampling approaches; reporting; review and adoption of strategies for economic development to ensure appropriate practices and measures to limit the discharge of nutrients and hazardous substances; and rehabilitating ecosystems that assimilate nutrients.

The requirements of EU legislation, including the 1991 Nitrate Directive, the 1991 Urban Waste Water Directive and the Water Framework Directive, have contributed to commitment towards nutrient reduction activities in many of the participating countries. In the beginning of the 1990s, Austria and Germany were the only EU members among the Danube-Black Sea Basin countries. By 2004, Hungary, Slovakia, the Czech Republic and Slovenia had also joined the EU, followed in 2007 by Bulgaria and Romania. The latest Danube country to join the EU was Croatia in 2013.

Behavioural change

More than 20 years of GEF investment in the region has contributed to strengthened institutional capacity in Black Sea and Danube River basins, formalized collaboration between the two, an improved understanding of the status of the Black Sea and the identification of priority sources of pollution. It has also included efforts to strengthen and harmonize water quality monitoring programmes in the two basins.

The greatest source-to-sea-related success of GEF activities in the region is perhaps the collaboration between the ICPDR and the Black Sea Commission, which enabled the formulation of common goals to restore of the Black Sea and contributed to the design of the Danube-Black Sea Strategic Partnership on Nutrient Reduction. The Strategic Partnership included two regional capacity-building projects, the Danube Regional Project and the Black Sea Ecosystem Recovery Project (GEF IDs 1460, 2042, 1580 and 2263); a series of investment projects dealing with watershed rehabilitation, wetland restoration, reduction of nutrient discharges and agricultural pollution control in eight Danube and Black Sea countries (GEF IDs 1074; 1123, 1159, 1351, 1355, 2141, 2143, 2970 and 3148); activities in the Dnipro Basin (GEF ID 2544); and other donor interventions in the basin targeting reduction of nutrients and toxic pollutants (notably from the EU Phare and Tacis programmes). The Strategic Partnership was launched in 2001 in the GEF International Waters focal area with a $97.70 million GEF grant, with co-financing of $288.76 million. The World Bank, UNDP, UNEP and other sources of financing, as well as 23 basin countries and the

Danube and Black Sea Commissions coordinated this initiative with the assistance of UNDP to address nutrient pollution and the associated eutrophication in the lower Danube and the Black Sea.

The extent of impact on public awareness has not been assessed, but the project activities in both the Black Sea and Danube River basins have (in line with the provisions of Water Framework Directive and the 1998 UN Economic Commission for Europe Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, the Aarhus Convention) included important components on public awareness, stakeholder consultation and involvement. Activities have contributed to reinforcing NGO networks (the Danube Environmental Forum and the Black Sea NGO Forum). The inclusion of small grants programmes to support NGO activities in the Black Sea and Danube River basins were particularly successful in increasing NGO participation. Events for the annual Danube Day (29 June) and Black Sea Action Day (31 October) engage large numbers of active participants in both regions. In the case of the Danube countries, activities have also helped shape government policy on how to deal with public participation in environmental decision-making.

When the EU Water Framework Directive was adopted in 2000, the non-EU member states of the Danube River Protection Convention also committed themselves to implement the WFD within the framework of the Convention. This greatly assisted the strengthening of policy and legislation among the countries in the Danube River Basin and contributed to the success of all ICPDR countries having developed policies and legal instruments for water management and nutrient reduction, all of the Danube EU countries establishing basin management plans and all of the non-EU countries indicating their interest in harmonizing with the requirements of the Directive.

The harmonization of national policy and legal instruments was more challenging among the Black Sea countries, where problems in the sharing of data and in reaching agreements on monitoring methodology persist. The terminal evaluation of the Black Sea Ecosystem Recovery Project notes that a Protocol for Land-based Activities had been elaborated, but was not yet ratified; no revisions to agricultural policy had been instituted to reduce non-point run-off; a coastal zone strategy for the region had been developed, but coastal zone plans were not implemented, and only two out of six countries had national laws and management instruments specifically on integrated coastal zone management (ICZM); and efforts to develop a legally binding agreement on fisheries had stalled.

Another challenge pointed out in the terminal evaluations of both the Danube Regional Project (1460 and 2042) and the Black Sea Ecosystem Recovery Project (1580, 2263) relates to the struggle to involve ministries and affect policies that fall outside the direct sphere of influence of the projects (e.g. water and environment ministries), a hurdle when trying to address resource those issues with the greatest impact on water quality (e.g. agriculture, transport and industry). The Danube Regional Project did include activities to promote, for example, best agricultural practices and the use of phosphate-free detergents, but the terminal evaluation pointed out that because of the difficulties in engaging relevant ministries, few changes were made to practices in farming and other industries that impair Danube water quality as a result of the project. The nitrogen and phosphate reduction achieved through the Danube Regional Project was likely assisted by the dramatic drop in agricultural production and resulting reduced fertilizer use after the economic downturn experienced by many lower Danube and Black Sea countries in the 1990s. In the case of the Black Sea Ecosystem Recovery Project, there was limited focus on agriculture despite its having been identified as a significant land-based source of nitrogen pollution.

Achievement of S2S related goals/targets

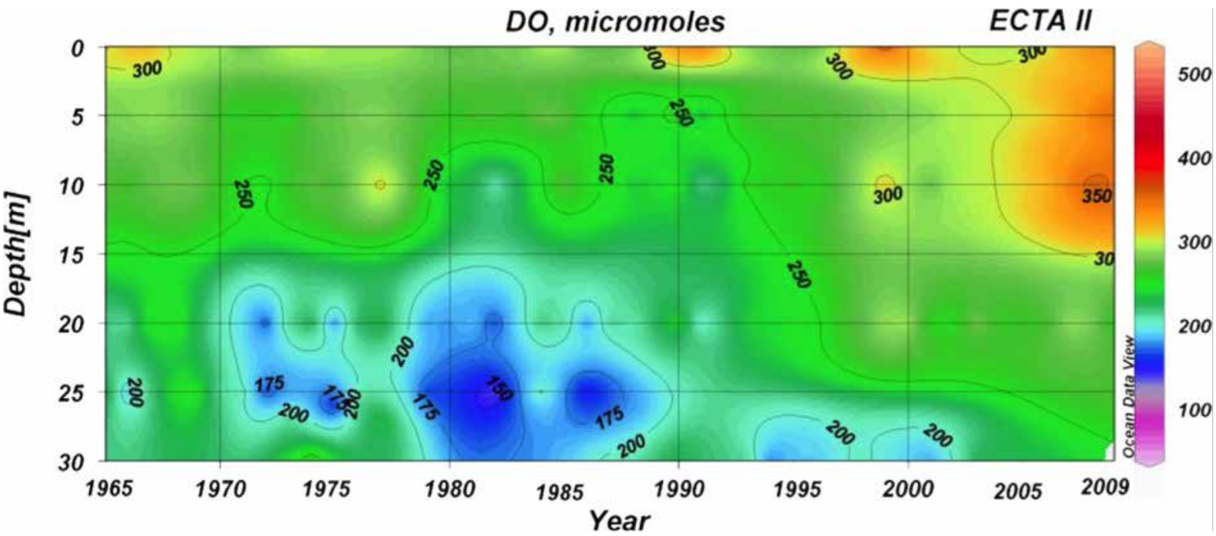
Significant improvements in the conditions of the Black Sea have been identified as a combined effect of the efforts of GEF and its Strategic Partnership, the European Commission and countries of the basin. Nitrogen loadings have been reduced by an estimated 25,000 metric tons per year and phosphorus by 4000 mt/yr, and have contributed to reduced frequency and extent of eutrophication and hypoxic events. The best practices for controlling eutrophication resulted from policy and regulatory reforms and three billion dollars in nutrient reduction investments for water treatment and improved farming practices. In 2007, it was noted that:

- The formerly expansive hypoxic zone covering the North West Shelf had been virtually eliminated.
- Oxygen levels were at near saturation in most areas.
- Diversity of benthic indicator species had roughly doubled since the 1980s.

- Invasive alien species (*Mnemiopsis leidyi*) had been significantly curtailed.
- The Upper reaches of the Danube Basin were no longer considered at risk.
- In the Danube Basin, nitrogen emissions had decreased by 20 percent and phosphorus almost by 50 percent over the previous 15 years (ICPDR, 2007).

The transition from extreme eutrophication and hypoxia from the mid-1960s to the mid-1990s, into a period of more highly oxygenated waters from 2005 to 2009 is depicted in Figure A1.

Figure A1. Reversal of eutrophication and hypoxia in the NW shelf of the Black Sea LME, as indicated in oxygen concentrations (μmol/l) off Constanta, Romania (blue and green correspond to low oxygen areas during periods of greatest hypoxia; orange illustrates return of more oxygenated waters).



Source: Hudson and Vandeweerd (2013).

Opportunities to achieve source-to-sea goals/targets at GEF portfolio level

The conclusion of the Danube Regional Project and the Black Sea Ecosystem Recovery Project marked the end, for the near future at least, of major regional GEF International Waters investment in the region.

It could, however, be opportune to explore potential synergies between planned GEF investment in Black Sea Basin countries and the Black Sea targets for nutrient and pollution reduction. Such synergies could also contribute to stronger engagement of those ministries that proved difficult to engage in the Danube-Black Sea Strategic Partnership. Examples include the Climate Change and Multifocal projects in Moldova, Georgia and Turkey, which would directly engage ministries of agriculture to strengthen the climate resilience and climate friendliness of the agricultural sector. The Green Cities Sustainable Transport project in Georgia is another example, as it takes place in the Black Sea coastal city of Batumi and provides potential links to targets related to atmospheric pollution.

Conclusions

Success factors in efforts to reduce nutrient pollution flowing to the Black Sea include early recognition of source-to-sea priorities – that is, the links between Danube River inflow and Black Sea environmental status – the formulation of common goals between the Black Sea Commission and ICPDR; commitment among upstream countries to nutrient reduction efforts (greatly assisted by the requirements of EU legislation); and the leveraging of significant additional funds from such institutions as the European Union, the European Bank for Reconstruction and Development, and the European Investment Bank.

The challenge of engaging government agencies that fall outside the sphere of water and environment is hardly unique for the Danube-Black Sea initiative. As suggested in the terminal evaluation of the Danube Regional Project, resource-oriented ministries would likely need to be engaged in a meaningful way from the start of project development to ensure their active involvement.

Remaining challenges in the Danube-Black Sea region also include effectively combining integrated river basin and coastal area management. In 2008, the EU Marine Strategy Framework Directive entered into force and the Black Sea was established as one of four European marine regions. The EU Marine Strategy aims for "good environmental status" of the EU's marine waters by 2020 and requires each member state to develop a strategy for its marine waters. The Danube River Basin District includes the coastal waters of Romania along the full length of its coastline as well as the Ukrainian coastal waters extending along the hydrological boundaries of the Danube River Basin. The coastal waters of Bulgaria have been assigned to another district. The ICPDR and Black Sea Commission are in the process of developing coordinating mechanisms for the implementation of the WFD in the coastal areas of the Danube River Basin District with implementation of the EU Marine Strategy Framework Directive in the Black Sea Coastal Waters.

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A3D. CASE STUDY: THE BALTIC SEA REGION

Authors: Sulev Nomman and Jakob Granit

Introduction – one sea, many source-to-sea issues

The Baltic Sea is one of the world's largest brackish water bodies. Approximately 200 rivers in the basin bring freshwater into the sea, which contributes to the sea's generally low salinity (ICES, 2003). The Baltic Sea region, including the sea and its river basins, has 85 million inhabitants and encompasses parts of nine littoral countries: Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden; and another five riparian countries: Belarus, Czech Republic, Norway, Slovakia and Ukraine. After the Second World War major reconstruction in Northern Europe was coupled with a strong industrialization movement in all the Baltic Sea countries alongside major modernization in agriculture. The large-scale industrialization and modernization of agriculture brought considerable wealth to some of the Baltic countries but also led to major environmental damage and liabilities, including loss of biodiversity, through the release of hazardous substances and high loads of nutrients in the Baltic Sea region ecosystem.[3]

The semi-enclosed Baltic Sea is probably the most thoroughly studied marine area in the world. The countries surrounding the Baltic have been collaborating on protecting the Baltic Sea environment since the 1970s. Decades of combating pollution have resulted in cleaner beaches and healthier seafood. While nutrient loading and chemical pollution are greatly reduced in the Baltic Sea, because of the past pollution legacy the basin remains the most eutrophic marine area in the world (HELCOM, 2014).

The Baltic Sea is also threatened by emerging pressures in two other key flows defined in the conceptual framework presented in this report: litter and materials. Marine litter has started to receive a lot

3 This description is based on Walline and Granit (2011).

of attention in recent years. The majority of litter is made up of non-degradable items, mainly plastics; in a monitoring study, plastic (in various forms) was the most common type of litter found on beaches of all types monitored in Finland, Sweden, Estonia and Latvia, accounting for over half of all litter. The shipping and fishing industries and household wastes are the main sources of marine litter. Household waste ends up in the sea via the wastewater flows, but also through direct dumping or littering into the waterways or the beach (HELCOM, 2015). However, according to the Baltic Marine Litter project MARLIN, more research is needed into the origins of marine litter. MARLIN attributes the increase in litter to current trends such as the popularity of disposable food wrappers and more accepting attitude towards littering (MARLIN, 2013).

Material flows are also increasing in the Baltic source-to-sea system due to intensified infrastructure development and construction in the marine space. Traditionally the Baltic Sea has been a major navigation hub and the site of significant port development. More recently, there has been growth in wind power development, and construction of longer bridges, gas pipelines and undersea cables connecting Baltic countries. Among other impacts, millions of tons of material (sand, concrete, etc.) have been dumped, dredged and/or transferred into the Baltic Sea, altering significantly seabed habitats, fish spawning areas, hydrography, and marine ecosystems.

Most of the existing studies in the Baltic Sea have been carried out in relation to major pressures, such as nutrient load, contaminants, industrial fishing and shipping. There have been very few studies related to material flows. In addition, the studies that have been performed on the impact of marine infrastructure development on the marine environment have been limited to analysis of single constructions and/or activities (largely national environmental impact assessments of the Nord Stream gas pipeline), or specific areas, rather than the cumulative impacts within the broader ecosystem.

Enabling conditions

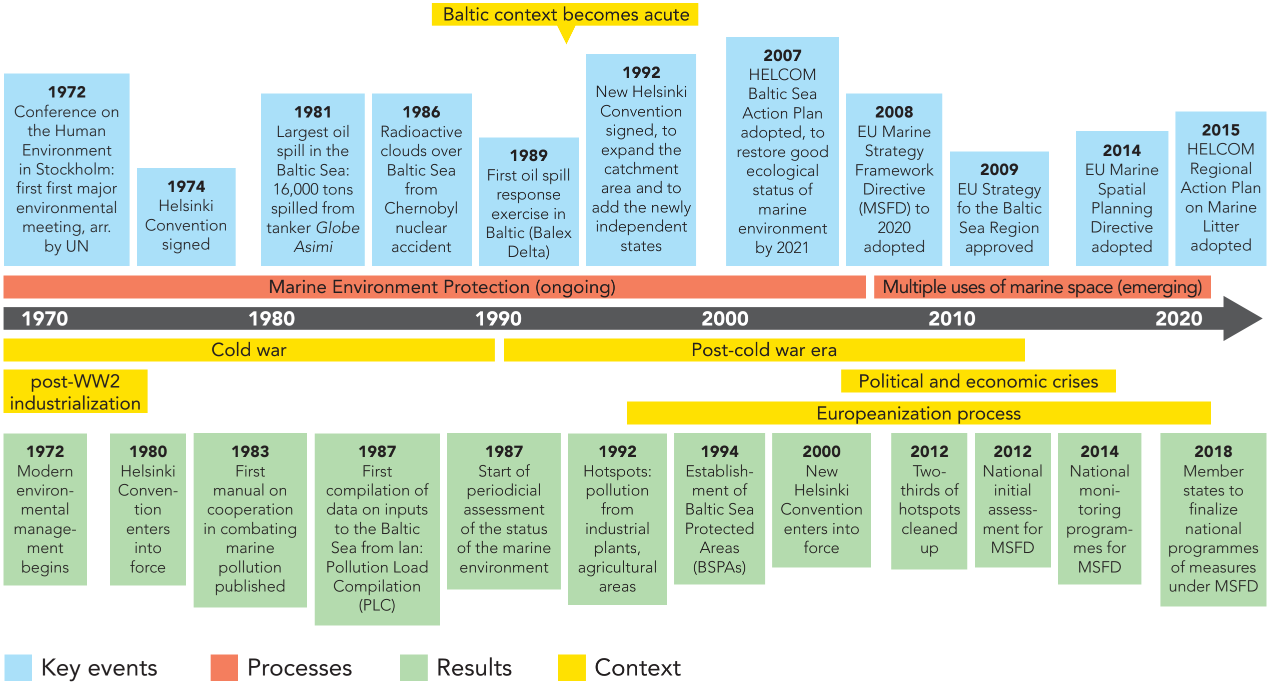
Enabling conditions for better governance of the Baltic Sea have emerged over a long period (see Figure A2). Major milestones have been the establishment of the Helsinki Commission in 1974; the collapse of the Eastern Bloc, to which several states on the Baltic had belonged, between 1989 and 1991; the EU Water Framework Directive in 2000, adoption of the HELCOM Baltic Sea Action Plan in 2007; the EU Marine Strategy Framework Directive in 2008; and the EU Directive on a Framework for Marine Spatial Planning in 2014 to name a few.

Common monitoring and information system development within the EU has influenced the evolution of governance in this region. For example, in 2007 the European Commission and the European Environment Agency launched the Water Information System for Europe (WISE; water.europa.eu), an information portal on European water issues for the general public and stakeholders to increase awareness and follow-up on water issues. EU WISE has since been extended to cover marine waters, including the Baltic Sea.

As the Baltic Sea is a shared resource, the majority of its governing institutions are transnational. International cooperation accelerated in the early 1990s, when major political changes took place and several newly independent states joined the EU. In October 2009, after intensive consultation with EU member states and stakeholders, the EU Strategy for the Baltic Sea Region (EUSBSR) was adopted by the European Council. The EUSBSR was the first EU macro region strategy developed, promoting coordination and investment across multiple sectors to restore and protect the Baltic Sea environment while supporting economic growth and competition throughout the region (Walline and Granit, 2011). The current EU strategy for the Baltic Sea Region is divided into three objectives, which represent the three key challenges of the strategy: saving the sea, connecting the region and increasing prosperity (EUSBSR, 2016).

The establishment of enabling conditions for change over such a large area as the Baltic Sea Region is complex. This is particularly due to the overlapping remits of the EU and its members states (which includes all Baltic countries except Russia) all of which are bound to implement, for example, the Marine Strategy and the Water Framework Directives and the mandate of HELCOM (which includes all Baltic states including Russia) where the cooperative efforts are based on the voluntary Baltic Sea Action Plan. Marine policies and legislation appear also not to have been developed in a coherent way and are to some extent overlapping. The recently initiated process of marine spatial planning (European Union, 2014) includes analysing and mapping the various human activities in sea areas aimed at achieving sustainable development by balancing environmental, economic and social objectives (European Commission, 2013;

Figure A2. Evolution of governance of the Baltic Sea



UNESCO, 2016). So far only marine spatial planning pilots exist across the Baltic Sea and no overarching spatial framework has yet been developed. As the marine spatial planning process continues in and between the EU Baltic Sea states, prospects for coordination and harmonized development may increase.

Behavioural change

Even though nutrient discharges into the Baltic Sea have been reduced in recent decades (HELCOM, 2014), progress has been slow. All coastal states have agreed on national nutrient-reduction targets (in the 2013 Copenhagen HELCOM Ministerial Declaration), but actions are arguably not being implemented fast enough (WWF Baltic Ecoregion Programme, 2013). In order to reduce eutrophication problems, societal behavioural change must be accelerated. Local actors and stakeholders have vastly different starting points when it comes to addressing seawater quality and eutrophication. For example, surveys have shown that two-thirds of the Baltic Sea countries' municipalities are either unaware of the problem or have insufficient resources to effectively address it (Dahlgren *et al.*, 2015).

For real change to take place, municipalities have to overcome three major challenges, according to a recent study (Dahlgren *et al.*, 2015). First, there must be wide understanding of the eutrophication challenges and opportunities among political leaders and citizens. A key success factor here is the ability to clearly demonstrate local socio-economic benefits. The next challenge is to identify which measures to implement in order to capture local benefits. There are many sources of anthropogenic phosphorus and nitrogen waterborne load, and therefore many measures to consider within the areas of wastewater, agriculture, stormwater, and restoration of coastal ecosystems. Following this, the third challenge is to identify the most cost-effective local combination of measures. Knowledge for this is often limited and business models are yet to be developed.

The HELCOM Regional Action Plan for Marine Litter, which was adopted in 2015, aims to significantly reduce marine litter by 2025 and to prevent harm to coastal and marine environments. Among several suggested actions, the most important in the source-to-sea context is the recommendation for HELCOM contracting parties (the nine countries with Baltic coastlines plus the EU) to seek cooperation with river or river basin commissions on reducing litter entering the source-to-sea system upstream, including on activities in the context of the implementation of the EU Water Framework Directive, the 2006 Bathing Water Directive and beyond. There is also a recommendation to share best practices and to analyse upstream waste flows and their impact on the marine environment. An example of actions that have resulted is a current assessment of the importance of sewage-related waste originating from the upstream waste flows, which is to be produced by 2017. The results will be shared with both river and river basin commissions (HELCOM, 2015).

Achievement of source-to-sea goals and targets

Cooperation in the Baltic Sea region can be argued to have met a number of targets according to the Orders of Outcomes presented in the theory of change for source-to-sea initiatives, but there are also major gaps. First Order outcomes are evident in terms of the enabling conditions described above and common goal-setting through the work of HELCOM over five decades, and more recently through the EUSBSR and related framework directives.

The institutional framework, however, shows inconsistencies and overlaps. The fact that most Baltic countries are EU members, while a major stakeholder, Russia, is not creates asymmetry in decision-making. The economic differences between the states in the region mean that they have different capacities to implement measures to address environmental degradation. Walline and Granit (2011) argue that an institutional assessment should be carried out to clarify the roles of existing Baltic Sea governance bodies and institutions and their linked legal obligations, including their arrangements with the EU's external partners in the wider Baltic Sea region: Russia, Ukraine and Belarus.

Second Order outcomes – changes in the behaviours of resource users to reduce stress in the source-to-sea system – have delivered some significant results. Hazardous substances being released into the Baltic Sea ecosystem from point sources have been significantly reduced, even though ecosystems are responding slowly. Diffuse-source pollution from agriculture, energy generation and transport has been difficult to target, since behaviour change in these sub-systems is difficult to regulate and control. Current major initiatives to promote renewable power generation and transport fuels, and ecological agriculture practices, are seeking behaviour change that can have positive impacts on the ecosystems. Trends towards sustainable production and consumption may also show to be promising for the Baltic Sea region as a whole. However, evidence demonstrates that pollutants that have been released into the source-to-sea system over the decades have been captured in sediments and are released through anoxic events or mechanical movement (HELCOM, 2010).

As a result, Third Order outcomes concerning changes in societal and environmental conditions show mixed results in the very large Baltic Sea region (European Court of Auditors, 2016), with multiple countries and the EU playing a key role as the broader political and economic union. However, cooperation to address problems in the basin such as tackling eutrophication or reducing hazardous substances from non-point sources requires the involvement of non-EU countries too. HELCOM, which includes all the littoral states, operated quite independently until the last decade and has, in the past, been criticized as ineffective in solving pressing Baltic Sea environmental issues. However, this may be changing. HELCOM has increasingly become more integrated into EU water governance mechanisms through the EU SBSR. For example, the European Commission has given HELCOM a larger role and even stronger mandate in its marine and maritime governance work. Regional conventions in general, such as the Convention on the Protection of the Marine Environment of the Baltic Sea Area, are globally recognized as the appropriate instrument for governance of regional seas. The Baltic Sea region is complex and institutional issues will continue to evolve on different tracks, and a strong and regional commission that enforces full authority over all the Baltic States does not appear to be in the making. However, the EU aquis as a whole calls for rigour in implementation in the environmental domains for the majority of the Baltic Sea basin states (Walline and Granit 2011).

It can be concluded from this case that the Fourth Order outcome – achieving a truly more sustainable and resilient source-to-sea system in which blue and/or green growth opportunities materialize in line with the 2030 Agenda for Sustainable Development – is still some way off. The political and economic realities of the region impact significantly on progress in different aspects of sustainability. A period of strong cooperation manifested by the 2009 EUSBSR and close relations with Russia has shifted towards a situation in which the EU is facing external and internal challenges and its relationship with its eastern external partners is under stress. Progress towards sustainability on shared natural resources demands long-term stability and cooperation. At the same time, a strong interest among many actors in identifying innovative solutions that drive sustainability is among the positive signs noted under Third Order outcomes.

Opportunities to achieve source-to-sea goals/targets at GEF portfolio level

The GEF played a catalytic role in its support to the GEF Baltic Sea Regional Project (BSRP), which was adopted in collaboration with HELCOM in 2003 (UNEP, 2005). The project was designed to promote an ecosystem-based approach to resource management under the principles of the LME approach focusing on land-based, coastal zone and marine activities. The project included social and ecosystem and management tools to support decision-makers in addressing transboundary issues. The World Bank was the implementing agency, and the project was executed by HELCOM and the International Council for Exploration of the Sea (ICES) and the governments of Estonia, Latvia, Lithuania and Russia. This investment demonstrated the importance of a global institution such as the GEF engaging in complex regions with major transboundary environmental challenges, to introduce new concepts of sustainability and cooperative practices. In 2004 Estonia, Latvia, Lithuania, and Poland became members of the EU. Their processes of "Europeanization" moved fast and the EU aquis was implemented in national laws in the new member states, including providing new financing opportunities with the EU regional cooperative framework (Walline and Granit, 2011).

As the Baltic case shows, it is essential to understand the political economy of change in the design of sustainable source-to-sea initiatives. A stronger focus on understanding governance through, for example, the proposed governance baseline approach in the conceptual framework introduced in this report could clearly be an important element for stakeholder-driven design of action along an agreed theory of change, and should be a key activity at the GEF portfolio level.

Conclusions

The Baltic Sea case provides some important inputs to building a robust source-to-sea conceptual framework. The Baltic Sea ecosystem demonstrates how the environmental impacts of past economic activities and drivers in the basin can take several decades to become visible in the form of, for example, eutrophication and the negative impacts of hazardous substances. From the beginning of modern transnational cooperation on the Baltic Sea region and through HELCOM, exploring interconnections, research and generating knowledge on key flows from land to sea has been an essential part of the cooperative agenda.

HELCOM as an institution was designed to operate in a difficult political context, tackling common challenges that were nevertheless perceived as less politically charged, such as environmental issues. This approach persisted during the cold war. The Europeanization period that followed with the expansion of the European Union and the introduction of the EUSBSR broadened the cooperative framework beyond environmental issues to include issues of growth, prosperity and deepening regional connections. Current political economic developments underline the importance of continuing to explore and analyse appropriate institutional frameworks as times change. Furthermore, this case shows the fundamental importance of developing a robust theory of change with clear goals and targets to build political will over time and with different actors.

The Baltic Sea region is well positioned to find and develop solutions to build sustainability. The EUSBSR demonstrates the importance most of the Baltic littoral states place on a holistic approach to sustainable development. Surrounded by developed countries sharing the same values and goals and equipped with necessary human and financial resources, the Baltic Sea region can be the most suitable pilot area for developing and testing modern source-to-sea and ocean governance mechanisms if cooperation with all the countries in the basin can be achieved and if the EU can continue to be a strong partner in cooperation

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A3E. CARIBBEAN SMALL ISLAND DEVELOPING STATES AND LINKS TO THE LARGER CARIBBEAN SEA BASIN – INTEGRATED WATERSHED AND COASTAL AREA MANAGEMENT

Author: Anna Tengberg

Enabling conditions

The 13 SIDS of the Caribbean include a variety of different and interlinked geomorphologic, geologic and socio-economic conditions encompassing: (i) large mountainous islands with relatively high population densities, large areas under agriculture and well-developed institutions (Cuba, Dominican Republic, Haiti, Jamaica); (ii) small low-lying islands, mostly devoted to the tourism industry, with highly vulnerable freshwater resources and well-developed institutions and private sector (Barbados, the Bahamas); and (iii) small volcanic islands, mostly mountainous, with relatively abundant freshwater resources (both surface and groundwater), low population densities and less developed institutional settings (Antigua and Barbuda, Dominica, Grenada, St Kitts and Nevis, St Lucia, St Vincent and the Grenadines, Trinidad and Tobago). Water resources, coastal areas and ecosystems in these islands are exposed to a number of stressors, including aquifer degradation, diminishing surface water quality and availability, loss of biodiversity in watersheds and coastal areas, and land degradation and coastal erosion. The root causes have been identified as being related to governance and include ineffective policy and legislative mechanisms; weak enforcement; and inadequate knowledge, information and capacity in applying integrated water and coastal area management.

The larger Caribbean Sea Basin is threatened by the impacts of sediment and nutrient discharges associated with poor land-use practices, urbanization and coastal development. Marine litter is another significant pollution issue for the Caribbean LME, with a high negative impact on sensitive marine species (e.g. sea turtles) and on the region's multi-million dollar tourism industry. In addition, sea level rise, increasing coastal water temperatures (often resulting in coral bleaching), ocean acidification, and increasing frequency and strength of extreme events such as tropical storms, hurricanes and droughts pose significant threats to the region's coastal zones and maritime areas, as well as regional economies.

To address common challenges, the Caribbean SIDS have established a number of regional organizations and bodies, such as the Caribbean Community (CARICOM) and technical agencies, such as the Caribbean Public Health Agency (CARPHA) and its Environmental Health Unit. CARPHA, together with the Caribbean Environment Programme (CEP; part of UNEP's Regional Seas Programme), have supported the development of the 1983 Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (the Cartagena Convention) and its 1999 Protocol on Land-Based Sources of Marine Pollution (LBS Protocol), which entered into force in 2010. The GEF has supported a series of projects on integrated water and natural resources management in Caribbean. The Integrated Watershed and Coastal Areas Management in Caribbean SIDS (IWCAM) project (2006–2011) focused on strengthening capacity to implement integrated approaches to the management of watersheds and coastal areas or ridge-to-reef, and strengthening the enabling environment. It also supported a number of demonstration projects to test approaches to reducing the impacts of land-based sources of pollution on freshwater and coastal environments. Integrating Water, Land and Ecosystem Management in Caribbean Small Island Developing States (IWEco) – a successor project to IWCAM – focuses on the application of existing proven technologies and approaches appropriate for SIDS, including sustainable land management and sustainable forest management, integrated water resources management and water use efficiency (WUE), and integrated coastal zone management and maintenance of ecosystem services, while enhancing resilience to climate change impacts. The GEF-Caribbean Regional Fund for Wastewater Management (CReW), established in 2011, provides sustainable financing for the wastewater sector, supports policy and legislative reform, and fosters regional dialogue and knowledge exchange among key stakeholders in the wider Caribbean region. The GEF project Sustainable Management of the Shared Living Marine Resources of the Caribbean Large Marine Ecosystem and Adjacent Regions (CLME) and its recently approved successor project to implement the agreed strategic action programme (CLME+) cover the Caribbean LME and the North Brazil Shelf LME. Major attention will be given to strengthening collaborative arrangements and enhancing institutional and human capacity and governance of coastal and marine ecosystems. Links

with the IWEco project are anticipated, but it is not clear how source-to-sea flows will be addressed.

According to its terminal evaluation, the IWCAM project created the foundations for the application of the IWCAM approach in the participating countries, strengthened the commitment to IWCAM of participating regional institutions and enhanced their capacity to sustain these efforts. The project also catalysed the beginning of a policy and institutional reform process, including development of IWRM road maps and policy statements, land and sea use plans, and establishment of national intersectoral committees to ensure the integration of IWCAM principles into the national policy framework. Moreover, IWCAM was instrumental in achieving the entry into force of the LBS Protocol. The project also catalysed the initial replication of best practices across countries, but had more limited success in engaging financial institutions for further investment and replication. However, the CReW project and its Regional Fund, which is being implemented by the Inter-American Development Bank (IADB), indicate that collaboration with financial institutions is now happening and that investment in best practices to reduce environmental pressures is being scaled up.

IWCAM also generated enhanced awareness of IWCAM at both national and regional levels, including decision-makers, national technical staff, media and community groups. Finally, it established an IWCAM process, stress reduction and environmental indicator framework. The recently initiated IWEco project will build on this framework to strengthen monitoring of IWRM/WUE, ICZM, SLM and ecosystem services provision, which could provide an opportunity to integrate a source-to-sea perspective and indicators for critical flows in future monitoring systems.

Behavioural change

Despite progress made by IWCAM, Caribbean SIDS still face major institutional and governance barriers to implementing integrated and cross-sectoral approaches to environmental management. Planning processes tend to be sectorally driven and do not take into consideration principles of ecosystem services flows. There are gaps in institutional mandates and in legislative and regulatory instruments that do not adequately address coordinated planning for IWRM, SLM and biodiversity management. However, the IWEco project is expected to address some of these gaps. It sets out to integrate different management approaches into watershed-based management, but it is still early to assess if behavioural change has taken place at national level beyond the demonstration activities supported by IWCAM. At the regional level, the CARICOM Secretariat has been charged with formulating a Common Water Framework, but very little progress has been made to date.

Nevertheless, the IWCAM terminal evaluation states that the project has triggered spontaneous replication and in some cases has induced catalytic impacts and stress reduction, notably in the domain of adoption of new management watershed/coastal zone schemes, as for example in St Lucia, the Dominican Republic and the Bahamas. In addition, new water and/or sanitation management policies were adopted in some countries (e.g. Jamaica, St Kitts and Nevis), and an innovative land and sea use plan in the Bahamas. As noted above, the establishment of the IADB-led Regional Fund for Wastewater Management is evidence that in investment targeted towards source-to-sea flows is increasing.

Achievement of source-to-sea related goals/targets

The systematic adoption of IWCAM policies and practices in the Caribbean SIDS is clearly a long-term process extending beyond the life of the IWCAM project. The IWEco project is therefore expected to deliver on some of source-to-sea-relevant stress reduction goals, such as increasing replication and investments in land degradation and effective land management in Antigua and Barbuda, integrated natural resources management in the Higuamo River watershed in the Dominican Republic, in the Soufriere watershed in St Lucia, and in the Georgetown watershed in St Vincent and the Grenadines, and biodiversity mainstreaming in coastal landscapes in Jamaica. However, it is not clear how management interventions across source-to-sea segments from upper watersheds to the coastal and marine areas will be linked and how approaches such as SLM, SFM, IWRM/WUE and ICZD will be harmonized.

Only modest stress reduction actions are foreseen under the CLME+ project, and they are all focused on fisheries. Critical source-to-sea flows related to pollution and coastal habitat management are thus not addressed under this project.

Opportunities to achieve source-to-sea goals/targets at GEF portfolio level

At the GEF portfolio level, it would be useful to clarify how improved management of critical source-to-sea flows (of sediments, pollutants, nutrients and litter) from upper watersheds to coastal and marine areas, to some extent addressed by the IWEco and CReW projects, are linked to environmental impacts in the Caribbean LME and could contribute to achieving targets under the SAP for critical habitats and targeted fisheries.

With the very complex governance arrangements in the Caribbean and its LME, and the many interlinked GEF-supported initiatives, joint reporting of common indicators and targets, as is done by PEMSEA for the East Asian Seas, could be useful in order to assess how common targets are reached and how critical flows along the source-to-sea continuum could be managed across segments.

Conclusions

The source-to-sea approach could provide a strong theoretical and conceptual underpinning for systematic analysis of ridge-to-reef approaches and critical flows in the Caribbean, using one overarching theory of change that would facilitate assessment of progress against common goals and targets. Better understanding of linkages between different segments in the source-to-sea continuum could also inform the development of common and cross-cutting indicators for SLM and SFM in upper watersheds, and IWRM/WUE and ICZM in freshwater and coastal segments.

Sources

Terminal evaluations for IWCAM and CLME, and project documents for IWEco, CReW and CLME+, all available at https://www.thegef.org/gef/gef_projects_funding.

A3F.
COLORADO RIVER, ITS DELTA AND LINKS TO THE GULF OF CALIFORNIA

Authors: Birgitta Liss Lymer and Machàngeles Carvajal

Enabling conditions

Since 1922, when the Colorado River Compact came into force, a number of acts and agreements have been adopted to allocate the water of the Colorado River between the upper and the lower basins, between states, between sectoral interests, and between native populations and federal public lands, while also approving a large number of dams and irrigation projects. Through the Mexican Water Treaty of 1944 (IBWC, 1944) about 10 percent of the river's annual flow is committed to Mexico. These various water allocation agreements only designated water rights strictly in terms of human use, with no water legally reserved for ecosystem health.

The Colorado River now supports an extensive system of dams, reservoirs and aqueducts serving a population of 40 million people with electricity, flood control and water for irrigation and municipal water supply, but does this by diverting 90 percent of the river's water in the United States alone. Prior to the 1930s, approximately 18,500 m3 flowed through the Gulf of California each year, supporting a broad riparian zone, numerous wetlands and an extensive estuary. Only 1,850 m3 pass the border of Mexico, the entirety of which is used to support agriculture and Mexican cities. The amount of water flowing into the sea has been reduced drastically. Except for a few periods of heavy precipitation the Colorado has not reached the sea since 1960 (Flessa *et al.*, 2013)

As a combined effect of the drastic water diversions and return flow from irrigation, salinity in the Colorado River rose dramatically in the 1960s and Mexico was receiving water that was too salty for human, livestock or agricultural use. No water quality standards had been established as part of the US-Mexican Water Treaty. In 1973, the US-Mexico International Boundary and Water Commission instructed the United States to reduce the salinity of water being delivered to Mexico (IBWC, 1973).

The Colorado River Delta once covered 780,000 ha of wetlands and riparian forests. This area has now shrunk to 60,000 ha, less than 10 percent of its original size (UNEP, 2004). What was once a brackish delta where sediment was deposited has turned into a hypersaline system experiencing significant sediment loss with impacts on spawning habitats and on feeding and nesting grounds for birds (Carriquiry and Sànchez, 1999). Fish, birds and other wildlife populations have declined dramatically.

The lack of river inflow also altered ocean and sediment circulation patterns, from largely unidirectional (from the river to the ocean) to cross-basin (Carriquiry and Sànchez, 1999). The combined effect of increasing fishing pressure over the same period, the changes in environmental conditions and the loss of spawning habitats has resulted in collapses of several fisheries in the Upper Gulf of California (or Sea of Cortèz) (Lercari and Chàvez, 2007; Carriquiry and Sànchez, 1999).

Despite its continuing state of decline, the Colorado River Delta had received little attention for several decades. In the mid-1980s and 1990s, accidental releases of water into the delta from full reservoirs had positive effects on the wetland ecosystem, which demonstrated the resilience of the riparian zone, and gave hope for its potential restoration (Glenn *et al.*, 2013; Flessa *et al.*, 2013). As a result, interest in the Colorado River Delta rapidly increased.

Responsibility for conservation of the delta is shared between Mexico and the United States, between governmental and non-governmental institutions, and between all water users. At a minimum, binational cooperation is needed to provide the legal framework required for collaborative efforts to succeed (Zamora-Arroyo *et al.*, 2008). In 1993, the Upper Gulf of California and the Colorado River Delta was established as a biosphere reserve (the first marine protected area in Mexico). Its management plan (CONANP, 2004) includes objectives in relation to the conservation of biodiversity and ecosystems of the Sonoran Desert, the Upper Gulf of California and the Colorado River Delta as well as the protection of marine species of ecological and commercial importance to the region, like the vaquita and totoaba (including their habitats, breeding and spawning areas).

In 2012, the United States and Mexico signed the most comprehensive water agreement between the two countries since the Treaty of 1944: Minute 319 (IBWC, 2012). This followed periods of drought in the Colorado River Basin, increasing recognition of

the potential adverse effects of climate change, and a growing numbers of research, community outreach and restoration activities in the delta. Its provisions include the implementation of a number of new measures and cooperative projects over a five-year pilot period lasting until the end of 2017. It allows the two countries to share the benefits in times of water surplus in the river, and the risks in times of shortage. It also stipulates joint management of reservoirs and the use of US reservoirs to store water for Mexican use, and includes binational investment in agricultural conservation, desalinization and water exchanges. Minute 319 also includes a binational delta restoration and flow programme that provides the means for environmental flows (both base flow and pulse flow for the delta), resources for monitoring, and restoration projects. One-third of the base flow to be allocated to the Colorado River in Mexico would be secured by the Colorado River Delta Water Trust, established in 2008 by a coalition of NGOs with the purpose of acquiring and leasing water for environmental purposes. The remaining two-thirds would be contributed by the USA and Mexico. The pulse flow is expected to flood low terraces and backwaters, move sediment, elevate the water table, and promote the germination of cottonwood and willow trees.

The Gulf of California/Sea of Cortèz is recognized for its high productivity and biodiversity, but is a highly fragile semi-enclosed sea with deteriorating environmental status due to shrinking freshwater flows, pollution from agrichemicals and urban waste, sedimentation, bottom-trawling, and over-exploitation of fisheries. Since the establishment of the Upper Gulf of California and the Colorado River Delta marine protected area, Mexico has made substantial efforts to protect more areas. However, the Gulf of California suffers from fragmented governance between the federal government and the surrounding five states and 40 coastal municipalities. It lacks a common regional development vision based on the long-term protection of the Gulf and its resources (Carvajal *et al.*, 2004).

Efforts in recent decades have included concerted action among researchers and civil society organizations to outline conservation priorities and achieve regional consensus on addressing these, spearheaded by coalitions such as the Coalition for the Sustainability of the Gulf of California and the Alliance for the Sustainability of the Northwest Mexican Coastline (ALCOSTA). A number of planning exercises have been undertaken over the past decade to identify priority areas for conservation, to document and assess biodiversity and threats and/or conflicts with human activities, and to guide conservation and resource use planning. However, despite being recognized as important, land-sea connections have received limited attention in such exercises (Alvarez-Romero *et al*, 2013). A process called Defying Ocean's End presented a regional cooperation agenda in 2003, noting the need for a permanent structure to put it into practice and specifying seven objectives to approach sustainability in the Gulf of California (Carvajal *et al*, 2004):

- Improve the management of regional marine and coastal protected areas;
- Enlarge the system of marine and coastal protected areas;
- Develop a comprehensive plan to manage and protect priority coastal wetlands;
- Reduce the shrimp trawling fleet and improve its fishing technology;
- Develop a regional plan to regulate the use of land, coasts and waters;
- Reorient regional tourism toward low-impact, environmentally sustainable resource use; and
- Articulate a common regional vision for development and build capacities for regional management.

Behavioural change

In the early 1970s the United States was faced with the challenge of meeting commitments to Mexico to control salinity in the Colorado River Basin (IBWC, 1973) and binding water quality standards set by the US Environmental Protection Agency in 1972. One response was to establish a programme to control salinity in the basin on both sides of the border. The 1974 Colorado Basin Salinity Control Act authorized significant federal expenditure for a desalting plant, diversion structures and a large bypass drain. The Act also included measures to reduce salinity through improved water- and land-use efficiency. More than US$30 million is now spent annually in the United States to prevent over 1 Mt of salt from entering the Colorado River (Bureau of Reclamation, 2013) through a combination of measures in irrigation management practices, erosion control, reduction in point-source inputs from natural geologic sources, and dam operation procedures. Addressing salinity through improved irrigation efficiency has also benefitted farmers, who received modern irrigation equipment, while improved water quality in the river helped protect their crops (Adler, 2007). The Yuma desalting plant, completed in 1992, stands as a last line of defence against overly saline water reaching Mexico, but has only been operated sporadically since its construction, primarily for demonstration and pilot runs4.

On the other side of the border, cooperation among NGOs, local communities, other water users, and state and federal agencies has improved the collaborative framework for restoration of the Colorado River Delta. This has in turn led to strengthened collaboration at the binational level (Zamora-Arroyo *et al.*, 2008), contributing to the signing of Minute 319 to the 1944 Treaty (Gerlak, 2015). According to an initial progress report of its environmental flows monitoring (IBWC, 2014) as stipulated by Minute 319, a pulse flow of approximately 130 million m3 was released to the riparian corridor of the Colorado River Delta from Morelos Dam at the US-Mexico border over an eight-week period that began in March, 2014. Base flow volumes totalling 65 million m3 are also being delivered to new and pre-existing restoration areas during the term of Minute 319 through 31 December 2017. In addition, non-native vegetation in restoration sites has been cleared and graded to promote regeneration of native vegetation, and portions of the sites have been replanted with native vegetation (IBWC, 2014).

Conservation efforts in the Gulf of California have had a strong focus on the creation and management of protected areas and measures to regulate fisheries and tourism development. As yet, none of the planning efforts has prioritized catchments to mitigate land-based threats and only one (that led by the Coalition for the Sustainability of the Gulf of California: Enríquez-Andrade *et al*, 2005) explicitly targets freshwater and terrestrial areas important to maintaining ecological processes connecting land and sea (Alvarez-Romero *et al*, 2013).

In the Upper Gulf of California and Colorado River Delta Biosphere Reserve, support from fishing communities for the objectives of the Reserve and related fishing restrictions waned after a few years. This, in combination with other challenges related to poor intergovernmental coordination and conflict among sectors (particularly fisheries and agriculture), poor institutional capacity, and limited law enforcement, have made it difficult to meet management objectives and as a result, illegal fishing continues to increase. The establishment of this reserve did, however, open the way for new protected areas in

4 http://www.usbr.gov/lc/yuma/facilities/ydp/yao_ydp.html, accessed April, 2016

the Gulf of California and led to discussions on the possibility of also protecting waters surrounding the islands in the gulf. Additional financial resources made available by the Mexican federal government and private groups have helped increase the capacity to manage protected areas in the gulf in recent decades (Carvajal *et al.*, 2004; 2010).

Achievement of source-to-sea related goals/targets

The United States and Mexico have met their obligations under the US-Mexico Water Treaty and subsequent amendments to address issues such as salinity and environmental flows to the lower Colorado River Basin. The salinity problem is, however, persistent. In order to meet the water quality standards in the lower basin by 2030, it is estimated that an additional 0.5 Mt per year of salt will need to be prevented from entering the Colorado River, costing an estimated US$45 million per year (Bureau of Reclamation, 2013). The pilot period of Minute 319 and the efforts to secure environmental flows to the Colorado River Delta lasts until the end of 2017. An evaluation of the pilot, including of its success in making water available for environmental flows, the environmental benefits derived and the ecosystem response, is expected by 31 December 2018 (IBWC, 2012).

There are still no overarching goals and targets for Gulf of California as a whole, and nearly all conservation efforts to date have focused on individual sites or on delivering narrowly defined strategies. That said, the efforts that are underway by a multitude of research, NGO and government efforts in the region are largely in line with the seven sustainable development objectives that came out of the Defying Ocean's End process in 2003.

Opportunities to achieve source-to-sea goals/targets at GEF portfolio level

Due to the transboundary focus of the International Water portfolio, the Gulf of California being a Mexican national sea and the Colorado River being shared by Mexico and the USA (which is not eligible for GEF support), GEF investment in the Colorado River Basin and Gulf of California region is currently limited to support to Mexico for the management of protected areas, POPs and polychlorinated biphenyls (PCBs). Opportunities to achieve source-to-sea goals and targets would depend on the interest of Mexico to seek GEF support to advance such efforts, building on the multitude of ongoing initiatives in the Colorado River Delta and the Gulf of California.

Conclusions

There are major efforts underway in the region to address some of the key environmental pressures faced in the Colorado River Basin, its delta and the Gulf of California. Some of these have been ongoing for decades, including salinity control in the Colorado Basin and efforts to regulate fisheries and strengthen marine area protection in the Gulf of California. More recent efforts to ensure environmental flows to the Colorado River Delta and to formulate management and governance goals for the entirety of the Gulf of California have largely been spearheaded by an active NGO and research community. The outcomes of these efforts and the extent to which they will manage to encompass system linkages across the source-to-sea continuum will be interesting to follow in years to come. As noted, consideration to land-sea interactions has so far been limited in recent planning efforts of the Gulf of California, despite their relative importance in certain areas of the Gulf. The source-to-sea approach could be helpful to facilitate stronger consideration of such linkages in future prioritization and goal-setting for conservation efforts in the region.

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APPENDIX 4.
DOMINANT MANAGEMENT APPROACHES AND TOOLS IN THE SOURCE-TO-SEA CONTINUUM

Approach	Objectives in relation to:	Governance Mechanisms	Main targeted source-to-sea segments
Sustainable forest management (SFM) – "a dynamic and evolving concept aims to maintain and enhance the economic, social and environmental value of all types of forests, for the benefit of present and future generations." (UNGA, 2008).	Forest degradation and deforestation while increasing direct benefits to people (livelihoods, income generation and employment) and the environment (carbon sequestration and water, soil and biodiversity conservation)	SFM is linked to the implementation of several multilateral environmental agreements and their associated national action plans/programmes: Biodiversity (national biodiversity strategies and action plans), UNCCD (national action programmes), and the UNFCCC (national communications).	Land resources and terrestrial systems Freshwater systems Estuaries/deltas (mangrove) Coastline and nearshore waters (mangrove) Adjoining sea and continental shelf Open ocean
Sustainable land management (SLM) – the adoption of land use systems that, through appropriate management practice, enables land users to maximise the economic and social benefits from the land while maintaining or enhancing the ecological support functions of the land resources.	SLM includes management of soil, water vegetation and animal resources. Ecologically, SLM technologies effectively combat land degradation. Socially, SLM helps secure sustainable livelihoods by maintaining or increasing soil productivity, thus improving food security and reducing poverty, both at household and national levels. Economically, SLM pays back investments made by land users, communities or governments (Liniger et al., 2011).	SLM is governend by the UNCCD structures at national level, including a national sction programme and the UNCCD National Focal Point. Sub-regional action programmes exist for priority transboundary dryland ecosystems and are often the responsibility of regional economic communities. According to the GEF strategy, SLM should use the landscape approach, which means that implementation is often only coordinated in one landscape or source-to-sea segment.	Land resources and terrestrial systems Freshwater systems Estuaries/deltas Coastline and nearshore waters Adjoining sea and continental shelf Open ocean
Spatial planning – "the methods used largely by the public sector to influence the future distribution of activities in space . . . Spatial planning embraces measures to co-ordinate the spatial impacts of sectoral policies, to achieve a more even distribution of economic development between regions than would otherwise be created by market forces, and to regulate the conversion of land and property uses" (EC, 1997)	To create "a more rational territorial organization of land uses and the linkages between them, to balance demands for development with the need to protect the environment and to achieve social and economic objectives". Spatial planning can be divided into a number of different disciplines including land use, urban, regional, transport and environmental planning and can include measures such as the establishment of Protected Areas.	Spatial planning is undertaken at several spatial scales, guided by administrative boundaries, where national and regional-level plans and accompanying regulations provide a framework to guide the development of local/municipal plans, which can then be used to guide development and the granting of permits for different activities.	Land resources and terrestrial systems (including urban) Freshwater systems Estuaries/deltas Coastline and nearshore waters Adjoining sea and continental shelf Open ocean

Approach	Objectives in relation to:	Governance Mechanisms	Main targeted source-to-sea segments
Integrated water resources management (IWRM) – coordination of development and management of water, land and other resources for maximizing of economic results and social welfare with no compromise on the environment (GWP, 2012).	The central principles of IWRM are participation, integration of the resources, institutions and stakeholders for sustainable water resources management.	Mechanisms for implementation of IWRM plans include establishment of an institutional framework at national level with interministerial/cross-sectoral IWRM steering committees. IWRM implementation at regional level involves establishment of a permanent framework for coordination and monitoring of water resources (PFCM). At the levels of countries and shared basins, the PFCM operates through a network of focal points.	Land resources and terrestrial systems (river basins) Freshwater systems Estuaries/deltas Coastline and nearshore waters Adjoining sea and continental shelf Open ocean
Environmental flows management: "provides the water flows needed to sustain freshwater and estuarine ecosystems in coexistence with agriculture, industry and cities" (Brisbane Declaration, 2007).	The goal of environmental flow management is to restore and maintain the socially valued benefits of healthy, resilient freshwater ecosystems through participatory decision making informed by sound science. Ground-water and floodplain management are integral to environmental flow management.	Environmental flow management is still only applied in a limited number of the world's rivers, but the Brisbane Declaration (2007) articulates that environmental flow assessment and management should be a basic requirement of IWRM; environmental impact assessment; strategic environmental assessment; infrastructure and industrial development and certification; and land-use, water-use, and energy-production strategies.	Terrestrial systems Freshwater systems Estuaries/deltas Coastline and nearshore waters Adjoining sea and continental shelf Open ocean
Integrated coastal management (ICM) –ICM evolved from the practical need to plan and manage the various economic activities that occur in coastal areas, regulate human behaviour, coordinate policy and management interventions, and integrate the use of coastal waters into land use planning (Chua et al., 2006).	ICM is based on three principles: adaptive management; integration and interrelationships; and ecosystem-based management. Its ultimate purpose is to increase the efficiency and effectiveness of coastal governance in terms of its ability to achieve the sustainable use of coastal resources and of the services generated by coastal ecosystems.	ICM is often applied at local government level and among networks of local governments, as for example in the PEMSEA case study, to strengthen planning and governance of coastal resources and scale up good practices to new municipalities and cities.	Land resources and terrestrial systems (coastal, including urban) Freshwater systems Estuaries/deltas Coastline and nearshore waters Adjoining sea and continental shelf Open ocean

Approach	Objectives in relation to:	Governance Mechanisms	Main targeted source-to-sea segments
Integrated coastal area and river basin management (ICARM) - ICARM is not a new management approach, but rather links the management approaches for coast and rivers (Pickaver and Sadacharan, 2007).	ICARM largely aims at a sectoral integration at all levels of governance as a basis for a multidisciplinary management of the larger catchment area, including the coast.	Mechanisms to implement ICARM largely rely upon coordination between the mechanisms responsible for IWRM and ICM implementation, as for example in the IWCAM case study where national inter-ministerial committees were established with this purpose.	Land resources and terrestrial systems (river basins) Freshwater systems Estuaries/deltas Coastline and nearshore waters Adjoining sea and continental shelf Open ocean
Ridge-to-reef approaches – there is no agreed definition on what constitutes a Ridge to Reef approach, but IUCN uses the following working definition: "A transformative, outcome-driven approach for managing river basins and coastal areas as a continuum of interconnected human (uses) systems and ecosystems characterized by improved governance, capacity and learning, and integrated at spatial scales to address emerging risks and ensure livelihood and ecosystem resilience."	Ridge-to-reef approaches are applied primarily in island contexts with the objective to maintain and enhance ecosystem goods and services (provisioning, regulating, supporting and cultural) through integrated approaches to land, water, forest, biodiversity and coastal resource management that contribute to poverty reduction, sustainable livelihoods and climate resilience (UNDP/GEF, 2014).	In the UNDP/GEF-supported initiatives in the Pacific, national inter-ministerial committees are established to support integrated land, water, forest and coastal management.	Land resources and terrestrial systems Freshwater systems Estuaries/deltas Coastline and nearshore waters Adjoining sea and continental shelf Open ocean
Ecosystem approach to fisheries (EAF) : – "strives to balance diverse societal objectives, by taking into account the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries" (FAO, 2003).	"To plan, develop and manage fisheries in a manner that addresses the multiple needs and desires of societies, without jeopardizing the options for future generations to benefit from the full range of goods and services provided by marine ecosystems."	EAF is the responsibility of national fisheries management organizations. For shared fisheries, implementation of EAF is often coordinated by Regional Fisheries Management organizations/ bodies, regional fisheries management organizations, regional fisheries bodies.	Land resources and terrestrial systems Freshwater systems Estuaries/deltas Coastline and nearshore waters Adjoining sea and continental shelf Open ocean

Approach	Objectives in relation to:	Governance Mechanisms	Main targeted source-to-sea segments
Marine spatial planning (MSP) – a public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that usually have been specified through a political process. Characteristics of marine spatial planning include ecosystem-based, area-based, integrated, adaptive, strategic and participatory approaches (Ehler and Douvere, 2009).	Spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives. The establishment of marine protected areas (MPAs), or networks of MPAs, could be an outcome of a Marine Spatial Planning process.	MSP is one element of ocean or sea use management; zoning plans and regulations are one of a set of management actions for implementing marine spatial planning. Zoning plans can then guide the granting or denial of individual permits for the use of marine space. MSP is also used in "areas beyond national jurisdiction" to protect ecologically and biologically significant marine areas and vulnerable marine ecosystems.	Land resources and terrestrial systems Freshwater systems Estuaries/deltas Coastline and nearshore waters Adjoining sea and continental shelf Open ocean
Transboundary diagnostic analysis (TDA)/strategic action programme (SAP) methodology – a collaborative process applied by GEF projects in multi-country surface water, groundwater and coastal/marine water systems to identify, quantify, and set priorities for environmental problems that are transboundary in nature (the TDA) and establish clear priorities for action to resolve the priority transboundary problems identified in the TDA (the SAP)	Resolving priority threats to international waters, including actions for the national benefit of each country, actions addressing transboundary issues and institutional mechanisms at regional and national levels for implementation of those actions (GEF, 2013).	To implement SAPs at the national level, International Waters support is provided by the GEF to the development of national action plans and establishment of national inter-ministry committees. At the regional level, support is provided from the GEF to etablish a regional mechanism/commission to implement ecosystem-based management in a selected river basin or large marine ecosystem.	Land resources and terrestrial systems (river basins) Freshwater systems Estuaries/deltas (mangrove) Coastline and nearshore waters (mangrove) Adjoining sea and continental shelf Open ocean

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